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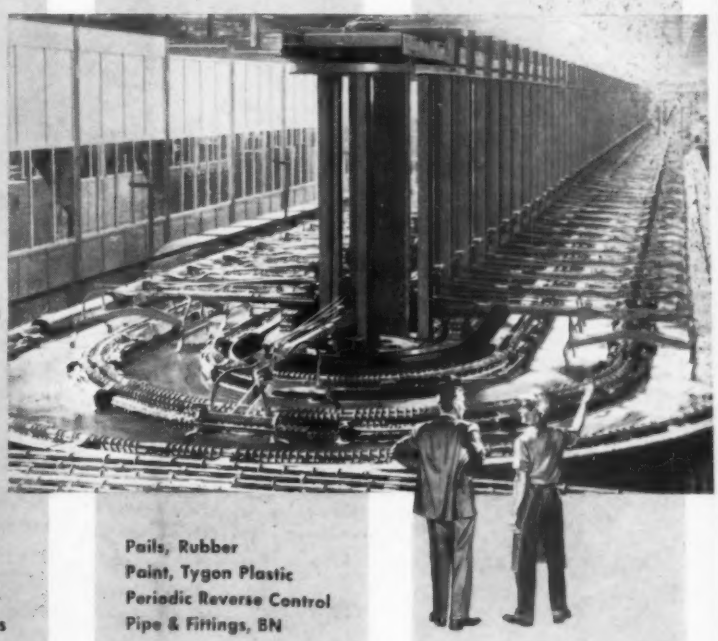

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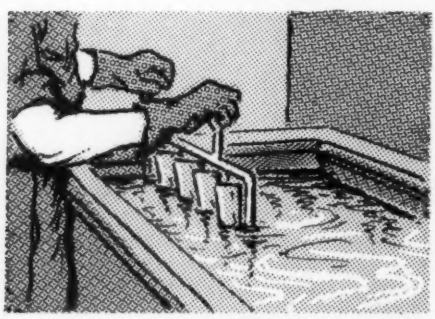

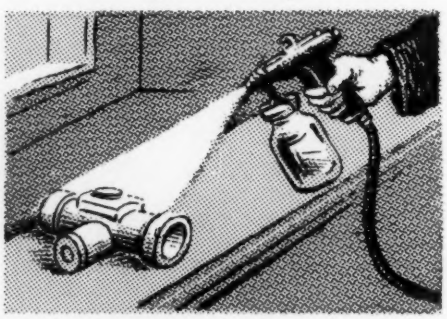

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The story of how one concern beat the nickel shortage when the Government cut nickel supplies, and how the new process has worked out.

Practical application of the use of polyhydroxy acid to prevent precipitation in aluminum etching baths.

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Hydrogen Embrittlement

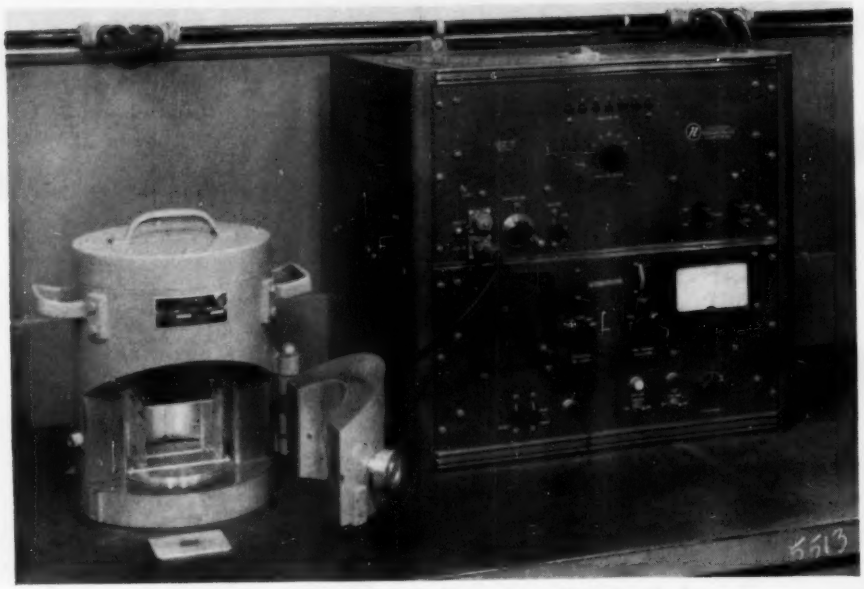
The susceptibility of high carbon steel, especially when hardened and tempered, to embrittlement by occluded hydrogen during the cycle of cleaning, pickling and plating needs no elaboration. Surely every plater has been blamed, at one time or another, for a lot of fractured springs. No vigorous exercise of the intellect is called for to deduce that the way to eliminate hydrogen embrittlement is to eliminate hydrogen. So far, so good! But, where do we go from there? The number of remedies compares quite favorably with those for the common cold, with probably the same percentage of successful ones.

Avoidance of cathodic cleaning eliminates one source without any inconvenience, since anodic cleaning is universal for steel. Because embrittlement has been found to be no major function of cathode efficiency, modification of the plating solution is not the answer, although acceleration of hydrogen absorption in the presence of cyanide and other ions would indicate the desirability of choosing the type of plating solution with care. The pickling and acid dipping operations appear to be the most vulnerable, therefore, for successfully attacking the problem.

Abrasive blasting and tumbling, instead of acid pickling to remove scale, are the obvious suggestions. Although, where practicable, these alternatives are the ones commonly employed, a subsequent acid dip is almost a must for deposit adhesion. Since penetration of hydrogen to a depth of only a few *billionths* of an inch is sufficient to embrittle a steel spring, the acid dip too often nullifies, to a great extent, the benefits of the previous operation.

Low temperature baking to expel hydrogen, although generally included in commercial and governmental specifications, is never completely satisfactory even before plating; after plating, it is doubtful whether the hydrogen can escape through the deposit. About a year ago the British Coil Spring Federation recommended special pickling procedures to minimize embrittlement and anodic pickling has been employed with some success. Since even the slightest amount of hydrogen occlusion, unfortunately, is capable of rendering hardened and tempered steel quite brittle, a completely dependable procedure is still to be discovered. Until then, as good a recommendation as any we have come across is to blame it on the heat treater.

Nathaniel Hall



Counting set-up used for radiometric evaluation tests described in this article.

Stripping Phosphate Coatings

Radiometric Evaluation of a New Stripping Solution

By Stanley L. Eisler and Jodie Doss[2]

Abstract

TESTS employing radiometric techniques were conducted to evaluate a solution containing sodium hydroxide and sodium cyanide alone and also with a sequestering agent as a stripping solution for phosphate coatings. The effect of the stripping solution on rephosphating efficiencies was also determined. It was found that a solution containing 24 oz. sodium hydroxide, 12 oz. sodium cyanide, and 12 oz. of sequestering agent (tetrasodium salt of ethylenediamine tetraacetic acid) per gallon was effective in removing iron, zinc, and manganese phosphate coatings. The iron and zinc phosphate coatings are removed by a simple immersion for ten minutes at room temperature while to remove manganese phosphate coatings it is necessary to make the work cathodic and operate the bath at 160°F. It was also found that no deleterious effects on the rephosphating efficiencies resulted from the use of this solution.

Introduction

Presently used government specifications for protective phosphate coatings for metals include a minimum coating weight requirement. These specifications require that the coating weight be determined by stripping the coating from the work by means of treatment in a sodium hydroxide or chromic acid solution.

Both of these methods present many disadvantages, as does the use of an ammonium hydroxide treatment which also has been used for the removal of phosphate coatings. The use of either alkaline treatment has not proved practicable, because of the mechanical scrubbing required and the ease with which the specimens corrode if not dried immediately. The chromic acid treatment is also impracticable because, if the solution is not discarded after each use, the formation of phosphoric acid during the stripping operation tends to etch the base metal of the test specimen giving high results for the coating weight. Also, it may be mentioned that the cost and limited supply of chromic acid are factors to be considered with recommending a solution to be used one time only.

This work was undertaken to evaluate a new stripping solution for phosphate coatings, which contains sodium hydroxide, sodium cyanide and the tetrasodium salt of ethylenediamine tetraacetic acid, a sequestering agent. This solution was prepared at this Arsenal based partially on information furnished in a brochure describing a commercial compound recommended for the removal of rust. This brochure states that alkaline salts and sodium cyanide are used in the abovementioned compound.

It was also deemed advisable to determine the effect that treatment in this solution would have on the efficiency of the phosphating process when the work was rephosphated, as is frequently done during renovation operations. This was considered necessary as work

1. The opinions or assertions contained herein are not to be construed as being official or reflecting the views of the Department of the Army.
2. Supervisor, Radiochemistry Section and Chemist, respectively, Ordnance Corps, Rock Island Arsenal, Rock Island, Illinois.

previously reported[3] indicated that complete removal of the original phosphate coating was a contributing factor to the production of a lighter weight coating during rephosphating.

The choice of radiochemical techniques to determine the efficiency of the coating removal process was made because of the extreme sensitivity afforded. If there is no residual activity, based on counting determinations, it may be safely assumed that all of the coating has been removed from the test specimen. Therefore, by use of a like procedure, a true coating weight determination may be made to satisfy the specification requirement.

Materials Employed

The tests were all conducted using circular discs made of S.A.E. 1020 steel as test coupons. These coupons were 0.975" in diameter and 1/16" thick with a 0.073" hole drilled 1/16" from the coupon edge for ease of handling with wire hooks.

The phosphating solutions used were made up to volumes of 10 gallons each. The zinc phosphating solution was a 27 point bath, while the manganese phosphating solution was a 60 point bath, as usually used in current commercial practice. Radiophosphorus in the form of $H_3P^{32}O_4$ was added to each of the above baths to give an activity level of approximately 0.05 microcurie per milliliter at the start of the program. Additions were made as required to compensate for loss in sludge formation and coating formation in order to maintain a counting rate for the phosphated coupons sufficiently high for statistical accuracy.

The radiophosphorus used for this investigation was procured from the Oak Ridge National Laboratory by authorization of the Atomic Energy Commission, Isotopes Division.

The stripping solution was also made up to a volume of 10 gallons and had the following composition:

Sodium Hydroxide	24 oz./gal.
Sodium Cyanide	12 "
Sequestering agent	12 "

Test Procedure

Five coupons were used for each test condition during the entire investigation in order to improve the statistical accuracy. After a thorough cleaning, the coupons were sandblasted on one side and then air blown. The coupons were then phosphated for 30 minutes in the zinc bath or for 45 minutes in the manganese bath, both maintained at a temperature from 195° to 250°F. After phosphating, the coupons were thoroughly rinsed in cold water and then immersed for 30 seconds in a chromic acid bath (3 oz. CrO_3/10 gal.) maintained at 190°F. and then air blown until dry. At this point in the procedure the coupons were counted to determine the initial counting rate.

The counting was done by placing the test coupon in the center of an aluminum slide held in a Lucite mount so that the surface of the coupon was approximately 10 mm. from the window of a mica window Geiger Müller tube operated in conjunction with a scaling unit. The entire assembly was inclosed in a 1½" lead shield to reduce the background count due to cosmic radiation and other sources. Initial counting rates were determined by counting for one or two minutes, depending upon the activity level of the bath, while stripped coupons were counted two or three minutes, depending upon the amount of residual activity present. Background counts were made for five minutes.

The counting rates of the coupons were also determined after treatment in the stripping solution. The conditions under which the stripping treatments were conducted included tests to determine the effect of temperature, time and polarity. In regard to polarity, the coupons were tested by the four following methods:

1. Simple immersion
2. Work as the cathode
3. Work as the anode
4. Periodic reversal of the current (10 sec. cathode, 5 sec. anode and repeat).

All tests involving the flow of current were conducted using a current density of 50 amp./ft.^{2} Coupons were thoroughly rinsed in cold running water after removal from the stripping bath.

The efficiency of the second phosphating was determined by rephosphating the stripped test coupons along with clean sandblasted coupons phosphated for controls. After phosphating and treatment as above, the coupons were counted and average net counting rates for each group of test coupons and the control group were determined. The efficiency of the rephosphating was then calculated and expressed as a percentage.

Salt spray tests were also conducted on some coupons after rephosphating to determine whether the corrosion resistance had been in any way impaired by the stripping treatment which preceded the rephosphating.

Preliminary Test Results

A preliminary test was conducted to survey the possibilities of the method. For this test, groups of five coupons were tested by attempting to strip the phosphate coating by each of the four methods previously described, and with treatment times of 1, 2 and 3 minutes for each method. Both zinc and manganese phosphate coatings were tested using each of the several test procedures. The results of this test are presented in Table 1. The per cent residual activity is calculated using the following formula:

$$\% \text{ Residual Activity} = \frac{\text{Av. net C/R after stripping}}{\text{Av. net C/R prior to stripping}} \times 100$$

The efficiency of the second phosphating is calculated using the following formula:

$$\% \text{ Efficiency of 2nd phosphating} = \frac{\text{Av. net C/R after 2nd Phos.} - \text{Av. net C/R after stripping}}{\text{Av. net C/R of Control Coupons}} \times 100$$

The residual activity counting rate is subtracted from the second phosphating counting rate as previously reported results[1] indicated that none of the residual

3. Eisler, S. L., and Chamberlain, P. G., "Radiometric Study of Phosphating Problems," Metal Finishing, v. 50, 113-116 (June 1952).

TABLE 1

Preliminary Test Results

Temperature of Stripping Bath = 160°F.

Treatment	Zinc Phosphate % Res. Activity	Zinc Phosphate Efficiency of 2nd Phos. %	Manganese Phosphate % Res. Activity	Manganese Phosphate Efficiency of 2nd Phos. %
1 Min. Immersion	0.2	84.4	25.9	35.7
2 Min. "	0.3	106.9	12.8	43.8
3 Min. "	0.1	105.3	2.4	57.9
1 Min. Cathode	0.1	119.5	9.3	57.8
2 Min. "	0.15	111.0	4.0	68.8
3 Min. "	0.1	108.5	1.8	70.8
1 Min Anode	0.4	72.1	30.8	36.2
2 Min "	0.2	74.2	2.4	61.6
3 Min. "	0.1	79.7	2.6	62.4
1 Min. Periodic Reverse	0.0	101.8	16.8	46.0
2 Min. "	0.0	116.1	0.15	105.8
3 Min. "	0.0	110.2	0.1	99.6

activity was removed during the rephosphating process.

The following facts may be noted from a study of the data presented in Table 1:

1. The anodic treatment was the least efficient of the four types of treatment, as indicated by the higher values for per cent of residual activity. Based on this fact and because the other types of treatment appeared to offer more promise, the anodic treatment was eliminated from further consideration.

2. The manganese phosphate coating was found to be more difficult to remove than the zinc phosphate coating regardless of the type of treatment.

3. Generally, the per cent of residual activity decreased and the per cent efficiency increased with increased time of treatment. The deviations from the above noted in the per cent residual activity values may be attributed in part to the inaccuracy of counting measurements at very low counting rates, i.e. slightly above the background counting rate.

Removal of Zinc Phosphate Coatings

Since the results obtained for the removal of zinc phosphate coating at 160°F. proved satisfactory, it was decided to investigate the possibility of operating the stripping bath at room temperature. This was considered advisable as it would obviate heating the solution which, in some installations, might not be practicable. The longer treatment time that might be required at the lower temperature was not considered objectionable in lieu of the simplification afforded by elimination of the heating of the solution.

A number of tests were conducted at room temperature (bath temperature approximately 85°F.) using all types of treatment with the exception of the anodic treatment and using various treatment times. The results of these tests are reported in Table 2, wherein the following salient facts may be noted:

1. The per cent residual activity decreased and the per cent efficiency of the second phosphating increased as the time of treatment increased, corresponding to the results of the preliminary test.

2. It may be concluded that it is necessary to reduce the initial activity to less than 1% to insure a second phosphating efficiency of 100%.

3. For the purpose of coating weight determinations, as required by the specifications for zinc phosphate coatings, any one of the following treatments may be recommended:

(a) A 10 minute immersion of the work without current.

(b) A 5 to 10 minute treatment with the work as the cathode.

(c) A 5 minute treatment with a periodic reversal of the current.

However, in the interest of simplicity and cost of an installation, the use of the immersion method presents a distinct advantage.

TABLE 2

Stripping of Zinc Phosphate Coatings at Room Temperature

Treatment	Test #3 % Res. Activity	Test #3 Efficiency of 2nd Phos. %	Test #5 % Res. Activity	Test #5 Efficiency of 2nd Phos. %	Test #7 % Res. Activity	Test #7 Efficiency of 2nd Phos. %
1 min. Immersion	22.2	20.7	35.4	10.3		
2 min. "	16.8	37.0				
3 min. "	3.5	86.8	11.3	43.0		
5 min. "			2.4	86.0	0.3	97.6
10 min. "			1.3	99.5	0.1	105.6
1 min. Cathode	14.5	54.7	28.7	29.3		
2 min. "	2.8	95.1				
3 min. "	1.8	101.2	2.9	90.3		
5 min. "			0.8	95.5	0.0	103.7
10 min. "			0.0	105.6	0.0	106.4
1 min. Periodic Reverse	16.6	55.1	24.5	30.3		
2 min. "	4.3	88.0				
3 min. "	1.5	94.0	1.8	89.4		
5 min. "			0.4	100.1	0.0	104.6
10 min. "			0.3	102.6	0.0	101.5

TABLE 3

Stripping of Manganese Phosphate Coatings at 160°F.

Treatment	Test #10		Test #11		Test #12		Test #13		Test #14	
	% Res. Activity	Eff. of 2nd Phos.	% Res. Activity	Eff. of 2nd Phos.	% Res. Activity	Eff. of 2nd Phos.	% Res. Activity	Eff. of 2nd Phos.	% Res. Activity	Eff. of 2nd Phos.
1 min. Immersion	8.8	61.0	17.0	43.5	18.0	38.7				
3 min. "	2.0	70.6	2.6	71.0	2.6	53.9				
5 min. "	1.9	59.9	1.5	74.1	2.1	61.6	1.5	63.5	1.8	58.6
10 min. "	1.8	59.3	1.9	60.5	1.9	64.0	2.0	64.1	2.0	53.6
15 min. "									1.6	58.4
5 min. Cathode							0.9	122.0	0.8	97.4
10 min. "							0.4	132.5	0.3	111.9
15 min. "									0.1	135.2
5 min. Periodic Reverse							0.0	148.5		
10 min "							0.0	108.9		

4. Slight variations in the per cent residual activity between two like tests may be explained by the fact that accurate counting determinations at low counting rates are extremely difficult to make. Another explanation of this variation is the fact that the counting rate of the phosphated coupons varied from test to test due to the decay of the radiophosphorus and variations in the efficiency of the phosphating process. Therefore, if the original count was lower, the residual count after stripping, although small, would constitute a higher percentage.

Salt spray tests were conducted on the coupons after the second phosphating of Test #7 and it was found that all coupons were free of rust after fifteen hours exposure. Test #10 was run to supplement the above results wherein the second phosphating was purposely made inferior, in order to compare the corrosion resistance of the coating with the counting rates of the coupons. This was done by using only a five minute phosphating treatment instead of the usual thirty minute treatment. The salt spray exposure time for this test was five hours. The results of this test were as follows:

Treatment	Ave. C/R	S. S. Result
1 minute immersion	836 C/M	Rusted
3 minute "	1125 C/M	O.K.
5 minute "	1168 C/M	O.K.
10 minute "	1047 C/M	O.K.
Control Coupons	1258 C/M	O.K.

The results of this test indicate that the counting rate may be taken as an indication of the amount of phosphate coating on the work and that the corrosion resistance will not be satisfactory until a minimum counting rate is attained. It is to be noted that this applies to zinc phosphate coatings only.

Removal of Manganese Phosphate Coatings

Referring to Table 1 and the per cent residual activity results for the manganese phosphated coupons, it will be noted that only the two and three minute periodic reverse treatments effected a reduction of the counting rate to less than 1% of the original counting rate. However, as previously mentioned, it was considered desirable to recommend a procedure which would involve as little equipment as possible. Therefore, a procedure at room temperature without the need for a current flow was to be preferred.

A test was conducted at room temperature using all three types of treatment with treatment times up to ten minutes. The results in all cases were negative as the lowest value for per cent residual activity was 33%.

Since the results of the test noted above indicated that the bath could not be operated at a lower temperature to remove manganese phosphate coatings, a series of tests was run at 160°F., using the three types of treatment and treatments times up to 15 minutes. The results of these tests are presented in Table 3. The following facts may be noted:

1. The decrease in residual activity and the increase in rephosphating efficiency with increasing treatment time follows the same pattern as previously noted.

2. Simple immersion treatments up to 15 minute treatment times are ineffective as indicated by residual activity percentages of over 1.5%. The ineffectiveness is also illustrated by the low rephosphating efficiencies.

3. Treatments with the work made the cathode in the bath were effective using a five minute treatment, but, as a safety factor, it is recommended that a ten minute cathodic treatment be used for removing manganese phosphate coatings for the specification coating weight test.

4. The periodic reverse treatment effects complete removal in five minutes, but, due to the expense of the necessary equipment, its use is not recommended.

5. The very high rephosphating efficiencies obtained in some cases may be attributed in part to the presence of a film on the coupons after stripping. This film would probably act as an accelerator during the subsequent phosphating process. Further work to determine if this heavier coating offers less corrosion resistance due to porosity will be discussed in a later section.

A salt spray test was conducted after the second phosphating using the coupons from Test No. 13. This test included the controls prepared by phosphating freshly sandblasted coupons. The results of this test after six hours exposure are presented below for comparison with the counting rates of the coupons after the second phosphating:

Treatment	Av. C/R	S. S. Results
5 minute immersion	754	Rusted
10 minute "	768	Rusted
5 minute cathode	1423	O.K.
10 minute "	1583	O.K.
5 minute periodic reverse	1767	Rusted
10 minute " "	1296	O.K.
Control Coupons	1174	O.K.

The results of this test substantiate, in part, the conclusions drawn from the salt spray test results for zinc phosphate coatings. There is, however, one major difference as shown by the result for the group of coupons stripped by a five minute periodic reverse treatment. This group of coupons rusted, although the counting rate, and it is assumed the coating weight, was the greatest. It may be then predicted that these comparatively high coating weights are less corrosion resistant due to their greater porosity.

Effect of Stripping on Rephosphating Efficiency

Several tests were conducted to determine if the high rephosphating efficiency obtained in the manganese coating tests were a function of a residue left by the stripping solution or whether it was due to the fact that a much cleaner surface was produced prior to phosphating. For each test duplicate groups of five sandblasted coupons were prepared. One group was then immersed in the stripping solution for 10 minutes. The temperature of the bath was room temperature for the coupons to be zinc phosphated, and 160°F. for those to be manganese phosphated. After this preliminary treatment for one group, both groups were phosphated in the usual manner and then counted. The results of these tests are presented in Table 4. The following conclusions may be drawn from an analysis of these results:

1. In every instance the treated coupons which were manganese phosphated counted higher while those zinc phosphated counted lower than the untreated coupons.

2. On the basis of the above noted reversal of behavior between the two types of coating, it may be concluded that this behavior is not caused by the coupons being cleaner after treatment in the stripping solution. This is true as it would be expected that a cleaner coupon would result in more coating being deposited from either bath.

3. Therefore, the behavior must be attributed to the presence of a film on the coupons which tends to enhance the formation of manganese phosphate but deter the formation of zinc phosphate. It is considered likely that this is a caustic film, which past experience has shown to be conducive to the formation of a heavy phosphate coating.

4. The similarity of the results for Test No. 11 indicates that in some cases the film may be removed, perhaps by excessive rinsing or other reasons.

5. Since the reduced efficiency shown in the table for zinc phosphated coupons did not appear when coupons had been phosphated prior to stripping and rephosphating the effect may be assumed to be inoperative under normal operating conditions. This is not true, however, for manganese phosphate coatings where this effect had been noticed in many previous tests with the resultant inferior corrosion resistance due to the heavier but more porous coating. On the basis of these results, the use of this stripping solution for stripping manganese phosphate coatings preparatory to rephosphating is not recommended.

Comparison of Stripping Solutions With and Without Sequestering Agent

An investigation was conducted to determine if the solution could be simplified and prepared at a lower cost by omitting the sequestering agent. A solution containing 24 oz./gal. of sodium hydroxide and 12 oz./gal. of sodium cyanide was prepared and used for this series of tests.

Two tests were conducted using the original stripping solution and the solution mentioned above in the same manner as the tests previously reported. Both zinc and manganese phosphated coupons were used and the type and time of treatment was as previously recommended for each coating. The tests also included a treatment time of 15 minutes in addition to the 10 minute recommended treatment time.

The results of these tests are presented in Table 5. The following conclusions may be drawn from the data presented:

1. In regard to the amount of residual activity remaining, it will be noted that there appears to be a slight advantage in favor of the original solution. This advantage is greater in the case of the manganese phosphated coupons. Therefore, in order to provide a safety factor, it is recommended that the original solution be used for all coating weight tests.

2. The rephosphating efficiencies were generally the same irrespective of the solution used for stripping. This was true, except for the manganese phosphate results for Test No. 15. Therefore, the use of either solution may be recommended for stripping zinc phosphate coatings, prior to rephosphating. The stripping of manganese phosphate coatings prior to

TABLE 4

Effect of Stripping Treatment on Subsequent Phosphating Efficiency

Test No.	Type Coating	Average net counts/min. Treated Coupons	Untreated Coupons
10	Zinc	794	1258
10	Manganese	1458	912
11	Manganese	1268	1243
12	Manganese	1730	1502
13	Manganese	1562	1174
13a	Zinc	947	1120
13a	Manganese	1427	1215
14	Manganese	1490	1166

TABLE 5
Comparison of Solutions With and Without Sequestering Agents

Treatment	Test 15				Test 15a			
	SOLUTION A		SOLUTION B		SOLUTION A		SOLUTION B	
	% Res. Act.	Eff. of 2nd Phos.	% Res. Act.	Eff. of 2nd Phos.	% Res. Act.	Eff. of 2nd Phos.	% Res. Act.	Eff. of 2nd Phos.
Zinc Phosphate								
10 min. Immersion	0.0	90.8	0.2	94.6	0.0	108.5	0.0	100.3
15 min. Immersion	0.0	93.9	0.5	99.9	0.2	103.0	0.0	97.2
Manganese Phosphate								
10 min. Cathode	0.4	123.2	1.3	82.6	0.4	128.1	1.2	124.0
15 min. Cathode	0.4	123.2	0.6	87.7	0.0	118.3	0.9	118.2

SOLUTION A contains sequestering agent.
SOLUTION B does not contain sequestering agent.

rephosphating using either solution is not recommended for the reasons previously mentioned.

Action on Bare Steel Surfaces

The recommendation of this new stripping solution for the removal of phosphate coatings for the specification coating weight test was based upon the assumption that the base metal would not be attacked. If there was any attack and subsequent loss in weight of the base metal, it can readily be seen that the method would produce inaccuracies in the coating weight determination.

In order to prove that the above assumption was correct, a series of weight loss determinations were made. Previously polished, cleaned and weighed 2″ x 3″ steel panels were immersed for 10 minutes in each of the two stripping solutions and then reweighed after rinsing and drying. It was found that the average weight loss per panel was about one milligram for the solution containing the sequestering agent and about two milligrams for the other solution. This would amount to a weight loss of about 12 and 24 milligrams per square foot, respectively.

These weight losses may, at first glance, appear to be excessive, but it must be noted that the solutions when used for stripping phosphate coatings would actually be in contact with the base metal for only a small fraction of the total immersion time used for the above testes. The weight losses noted above also compare very favorably with those resulting from the use of the chromic acid solution required by present specifications.

Therefore, it may be concluded that stripping of phosphate coatings using either solution will not introduce an error of sufficient magnitude to effect the validity of the coating weight test.

Removal of Iron Phosphate Coatings

The use of iron phosphate coatings has been proposed for a base to be used principally under enamels or varnishes which require high temperature baking operations. Therefore, information is required as to the ability of the new stripping solution to remove the iron phosphate coating for the purpose of coating weight determinations.

A limited number of tests were conducted using coupons phosphated by a 30 minute immersion in a bath containing 5 oz./gal. of commercial iron phosphating compound and radiophosphorus as a tracer. The bath was operated at a temperature of 160°F. The treatment time was increased from the usual five minutes to thirty minutes, in order to increase the weight of coating and consequently the counting rate of the phosphated coupons. In spite of this increased treatment, the counting rates were considerably lower than desired for good statistical accuracy.

The stripping results, as determined from the residual activity measurements, indicated that all the iron phosphate was removed after a ten minute immersion at room temperature using either of the two solutions. Therefore, the recommendations as made for the removal of zinc phosphate coatings would also apply to the removal of iron phosphate coatings.

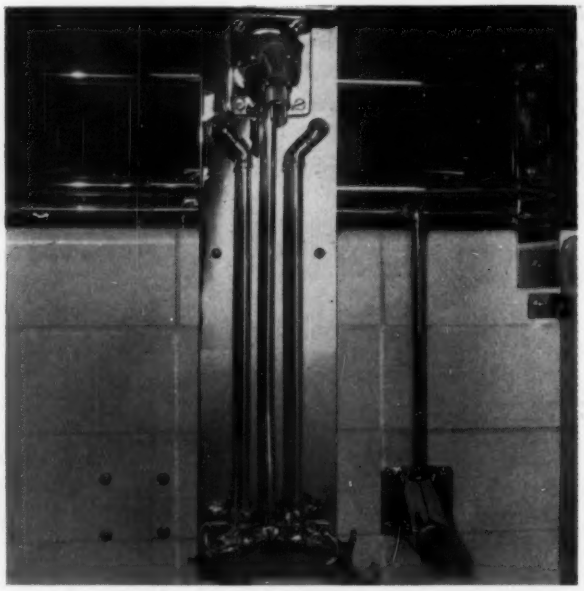
Summary

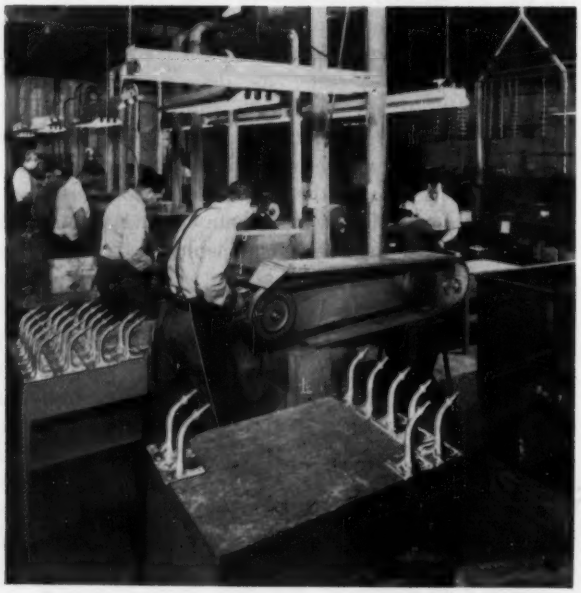
The use of the solution containing the sequestering agent is recommended, although the cost would be considerably higher than the simple caustic-cyanide solution. It is felt that this is justified because of the extra margin of safety provided. Since the new solution may be used for an indefinite length of time as compared to the chromic acid solution which is to be used only once, the cost of the original volume of solution would be reduced considerably on a comparative basis.

The test results presented in this report prove conclusively that the new stripping solution may be used for determination of the coating weights of all types of phosphate coatings. This procedure will not lead to any spurious results due to etching or dissolution of the base metal.

The use of the new stripping solution for stripping phosphate coatings prior to rephosphating was also found to be effective for zinc phosphated work. It is also possible that, if sufficient vigorous rinsing after stripping is employed, that manganese phosphated articles may be stripped and rephosphated. However, it is felt that further work should be done on the rephosphating of manganese coatings before a formal recommendation is made.

The authors wish to express their appreciation to their co-workers at the Rock Island Arsenal Laboratory for their assistance and to the Ordnance Corps, Research and Development Division of the Department of the Army and the supervisory staff of the Laboratory for permission to publish the information in this paper.





Small Plants Can Produce Good Work

Methods and Equipment Used for Quality Production

By Fred M. Burt

SOME plated products do not require a finish that will stand a lot of abuse and are not expected to maintain a bright, shiny finish over a very long period of service. This applies to a wide variety of units and on the majority of them there is a close, competitive price to the ultimate user. Therefore, the base metal coated may be in the lower price range and the plating may be done on large volume, continuous production lines, using automatic equipment. However, when the utilization of the product justifies the employment of the very best of plating methods calculated to produce an unsurpassable end product insofar as the plating is concerned, different metal surface preparation and plating operations are required, along with very extensive and up-to-date experience in doing quality work.

In doing demanding plating work, cost and time-savings can be effected by various methods, excluding more or less automatic mechanical handling. The chromium plating methods described in this article are those falling in the latter category and the quality of the finished products must conform to simple but extremely rigorous standards. They are shower equipment parts that are most pleasing to the eye, with the most durable plated finish that can be applied. The big cost-saving in using such units is provided by their lifetime service without noticeable deterioration.

This work is done at *Plating, Inc.*, in Glendale, Calif., a custom chromium plating shop, where all plating is done on brass with one exception, cadmium plating of steel anchor plates for shower heads. Currently, most of the production capacity of the shop is utilized for the plating of nearly 400 shower and allied equipment parts for the *Logan Mfg. Co.*, an affiliated company. They are all made of red brass; principally sand castings and machined units turned from bar stock; also stampings such as pipe supports, for example, and forgings such as valve handles. The only job plating done for other customers is also on brass units and with the same quality standards of plating that apply to the Logan parts. No work is done on a cut-price basis.

The shop contains 1200 square feet of floor space, including office and shower-locker room, and a high standard of plant good housekeeping is maintained, with a place for everything and everything in its place, and no dead storage in operating spaces. Currently the normal personnel consists of production manager, *B. C. "Bernie" Gardes;* 14 polishers, including lead man, *Roy Collier;* 2 platers, including head plater, *John Gerz,* and 2 platers' helpers. All maintenance

work is handled by *Machinists, Inc.*, (another Logan affiliate) in an adjoining area in the same building.

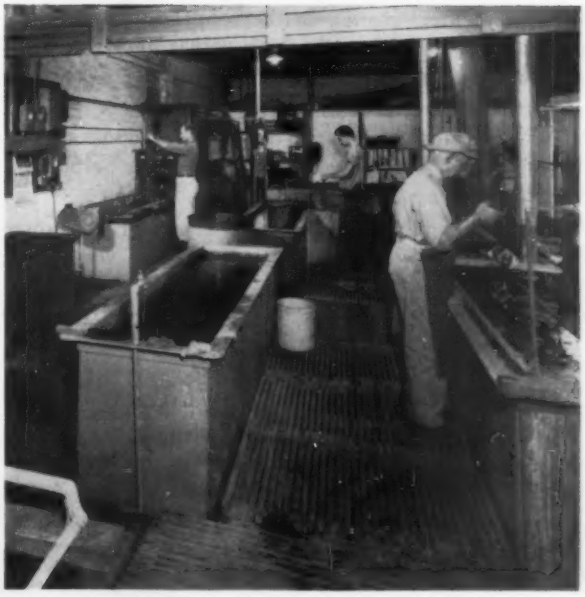
Following through the cycle of operations, we start with polishing, with equipment consisting of 8 variable speed lathes equipped with idlers. Polishing is done with belts, 60 down to 320 grit, as indicated by the character of the surfaces to be polished. Small fittings are deburred on a strap belt machine.

After polishing, parts are buffed on 2 single drive lathes, each with 2 buffing wheels, and 1 lathe with split shaft and twin drives for 2 buffing wheels; heavy buffing is done on this unit. After cutting down, parts are cleaned in a gas-heated vapor degreaser, with a capacity of 1½ drums of trichlorethylene, and then go back to the buffing lathes for color buffing, using a special lime compound. Extreme care is taken in polishing and buffing, with close inspections, in order that all surfaces of the brass parts shall be in the best possible condition for subsequent plating. Then follows the racking of parts preparatory to plating.

The plating sequence is as follows:

1. Electro-cleaner, 7 oz. to gal. — 500 gal. tank.
2. Water rinse — 300 gal. tank.
3. Copper strike — using a standard solution containing caustic soda, potassium cyanide and copper cyanide — 450 gal. tank.
4. Copper plating, standard Rochelle copper solution — 450 gal. tank. Copper plating is done on all of the larger brass castings and on other parts with any porosity that indicates need of copper plating to provide a perfect surface for further plating operations.
5. Water rinse (2).
6. Sulphuric acid rinse — 4% H_2SO_4 by volume — 300 gal. tank.
7. Water rinse (2).
8. Second water rinse — 375 gal. tank.
9. Bright Nickel — 500 gal. tank.
10. Water rinse (8).
11. Chromium — (32 oz./gal. chromium solution) 500 gal. tank.
12. Reclaim rinse.
13. 3′ x 2′, four-jet, spray rinse tank, on side of (10).
14. Clean 500 gal. hot water tank (150-200°F.).
15. Inspection and unracking.

A new 250 gallon tank, placed back of the degreaser, will be used for the small amount of cadmium plating done. The bright nickel and chromium plating tanks are lined with Koroseal, also a 500 gallon auxiliary nickel tank. The sulphuric acid dip tank has a rubber lining. Two 75 gallon cylindrical tanks also have Koroseal linings, one containing a hydrochloric acid solution for cleaning racks, the other one is the sulfuric acid electrolytic strip tank. In the latter, an 80% acid solution is used to start and, when it picks up enough water to start etching, more concentrated acid is added. Two 1500 ampere rectifiers supply current for the electro cleaning and plating tanks. Under the wooden floor racks, between and around the tanks, there is a waterproofed concrete floor. The tanks containing various solutions drain into a sump for neutralizing before entering the city sewer system. Strength of solutions is checked by titration; nickel daily, others weekly.



Anodes for Electroplating

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ANODES are of importance to all of us in the electroplating industry since, through the exercising of sufficient care in their selection and their use, many worthwhile cost savings can be made. This article covers, first, the common forms of anodes used in copper, cadmium, zinc and nickel plating. Then consideration is given to some special points that apply to anodes in general.

Copper Anodes

Starting first with copper, we find that there are three forms of anodes in general use — electrolytic, cast and rolled. Of the three, the electrolytic is the form most widely used in Canada.

In its final purification the raw copper is made the anode in an electrolytic cell with a thin sheet of copper as the cathode. With the passage of direct current the impure copper is dissolved in the electrolyte and plates out on the copper starting sheet in purified form. The impurities either remain in the solution or come out as sludge and, incidentally, high values of silver, gold and platinum are obtained from this sludge.

The original size of these electrolytic copper sheets is 38″ x 38″ and, in order to make copper anodes from the sheet, it is merely necessary to cut to size and drill holes for the hooks.

A typical analysis of electrolytic copper is shown in Table I. It will be seen that it is of very high purity. Both the cast and the rolled anodes are of similar composition since they are made from the electrolytic material. They do, however, contain traces of other metals which are added in connection with the melting for the purpose of deoxidizing.

Naturally both the cast and the rolled copper anodes are somewhat higher in price than electrolytic copper and, because of the excellent results obtained from the electrolytic sheets, there is very little justification, in the author's opinion, for the use of cast or rolled anodes except where curved anodes are required, as for barrels, or where anodes longer than 38″ are required.

One problem often encountered in connection with high speed copper plating is polarization of the anode at the high current densities used. A black film forms over the anode and, since rough deposits may result from particles dislodged from this film, the current density must be kept within limits. The laboratory carried on some experimental work designed to indicate the effect of the various plating conditions on the formation of this film. The results of this work are given in Tables II to VI.

Cadmium Anodes

Cadmium is supplied by the producers of the metal in the form of balls, bars and sticks and a typical analysis of this material appears in Table VII.

Any of these forms of cadmium may be cast into other shapes, usually straight or curved elliptical anodes. Because of the cost of casting, however, such anodes are more expensive than the primary forms. The form of cadmium usually preferred is the ball shape which is used in steel wire cages.

Among the advantages of ball anodes are:

(1) Being a primary form of cadmium, there can be no less expensive source of the metal.

(2) The balls give very high surface area in relation to weight. This means that a good anode surface area can be provided without an excessively high investment in cadmium.

Zinc Anodes

All zinc anodes sold in Canada are cast but there is some variety as to shape, which include balls, flat

TABLE I

Typical Analysis Electrolytic Copper

Copper	99.967%
Sulphur	.001%
Oxygen	.025%
Iron	.0006%
Nickel	.0006%
Arsenic	.0005%
Antimony	.0004%
Lead	.0002%
Tellurium	.0005%

TABLE II

Effect of Potassium Carbonate Content

Potassium Carbonate oz./gal.	Limiting Anode Current Density amp./ft.^{2}
0	44
1	30
2	30
4	28
6	28
8	26
10	18
15	16

Standard concentration. Free potassium cyanide 1 oz./gal. Temp. 160°F.

TABLE III

Effect of Addition Agent

Concentration oz./gal.	Limiting Anode Current Density amp./ft.^{2}
0.00	44
.10	45
.20	48
.25	48
.30 (normal)	50
.35	52
.40	46
.50	42
.60	18

TABLE IV

Effect of Sodium Thiocyanate

Concentration oz./gal.	Limiting Anode Current Density amp./ft.^{2}
0	42
.5	44
1.0	44
1.5	44
2.0 (normal)	44
2.5	46
3.0	40
3.5	38

TABLE V

Effect of Temperature

Temperature, °F.	Limiting Anode Current Density amp./ft.^{2}
161°	44
169°	36
175°	34

TABLE VI

Effect of Free Potassium Cyanide

Concentration oz./gal.	Limiting Anode Current Density amp./ft.^{2}
1.0	44
1.5	46
2.0	54
2.5	60
3.0	76

TABLE VII

Typical Analysis of Cadmium Anodes

Cadmium	99.968%
Copper	.003%
Tin	Nil
Iron	Trace
Zinc	.017%
Manganese	.020%
Lead	.012%

tops and elliptical. As in the case of cadmium, the most popular shape is zinc balls used in anode containers. This approach affords a simple way of providing plenty of anode surface with a minimum investment in metal. Flat top shapes can also be used in this way.

Zinc anodes are available as high purity zinc but, unlike cadmium, pure zinc is far from being an ideal anode material. This fact has resulted in the development of alloy zinc balls with special properties.

There are two serious objections to the use of pure zinc as an anode for plating:

(1) Most bright zinc plating solutions contain from 10-20 ounces per gallon of caustic soda and in this bath pure zinc anodes will not only dissolve electrochemically at 100% anode efficiency, but will also dissolve chemically whether or not the current is on. This means that the effective anode efficiency is over 100% as compared with the cathode efficiency of from 80 to 85%. The result of this situation is that the bright zinc plating bath may build up in zinc content due to the high rate of anode activity. Now one of the most important factors in the control of bright zinc plating is the maintenance of the proper ratio of total sodium cyanide to zinc. This is very important if the maximum plate brightness is to be obtained. This means that every time the zinc content increases one ounce per gallon, about three ounces per gallon of sodium cyanide must be added to restore the ratio. Eventually we come to the point where the pace becomes too expensive and part of the solution is discarded in order to bring the bath into balance. Then, of course, the same cycle is repeated. This build up in zinc content which frequently occurs when pure zinc anodes are used increases considerably the cost of zinc plating. This type of problem does not arise, of course, where the dragout is very large since, under such conditions, the operator is solving the problem by wasting chemicals and the extra cost is still there. The problem of rising zinc content is not so serious where tanks are in continuous operation 24 hours a day. In this case there is no build up in zinc content through chemical action during idle hours.

(2) The other objection to the pure zinc anode is that it produces a large quantity of fine black sludge. This sludge cannot be completely fiiltered out and, where a fairly heavy plate is desired from a still tank, rough or spotted deposits will result.

Let's see how alloy anodes solve these problems. Where the first problem is severe, that is zinc content of the bath is continually rising, anodes having a depressed anode efficiency are the answer. A patented alloy having a small fraction of 1% of an alloying metal added to high purity zinc provides this type of anode. The depressed anode efficiency is then only slightly greater than the cathode efficiency and, with normal dragout, there should be no build-up of zinc content, (neither should frequent additions of zinc cyanide be required. These anodes come in two grades, one for still tanks where there is a severe problem of zinc build-up and the other, containing less alloy, is for barrel installations and for still tanks where the problem of rising zinc content is present only in a milder form.

These alloy anodes, then, keep the zinc content from

TABLE VIII

Typical Analysis of Zinc Anodes

(Special High Grade)	
Zinc	99.993 %
Lead	0.0031%
Cadmium	0.0017%
Iron	0.0010%
Copper	0.0007%

rising too rapidly but they still give just as much sludge as the pure zinc anodes and for this reason are not the answer where elimination of sludge is important.

In most zinc plating the appearance and smoothness of the zinc deposit is of great importance and anode sludge must be eliminated as much as possible. Here another type of alloy anode made of pure zinc with less than 1% aluminum added is recommended. Although this anode is not sludge free, it is nearly so, giving off perhaps 1 or 2% of the amount of anode sludge that comes from pure zinc anodes.

This alloy does not have a depressed anode efficiency like the previously mentioned types but is pretty well immune to chemical attack when the bath is idle so that there is usually very little trouble from rising zinc content. This anode can be used either in a still tank or in a barrel and it is the anode that gives best results in bringht zinc plating.

Nickel Anodes

As regards anode tonnage used, nickel is by far the most important type of plating.

Four types of nickel anodes are in commercial use in Canada today. They include:

(1) Cast, 95/97%
(2) 99% + Rolled Depolarized
(3) 99% + Rolled Low Carbon
(4) 99% + Cast Low Carbon

The cast 95/97% and the rolled depolarized nickel anodes are used only for dull nickel plating baths such as the Watts type. In baths of this type, which are usually operated at a pH of about 5.3 electrometric, the rolled depolarized anode dissolves most smoothly and with a minimum of sludge. This anode can be bagged without any danger of anode polarization. In spite of the excellent results obtained with the rolled depolarized anode, there are, nevertheless, large quantities of the 95/97% cast nickel anodes used in dull nickel plating baths in Canada. As these anodes dissolve, a heavy carbon film develops on the surface and the practice usually is to remove the anodes from the tank and brush away the carbon film from time to time. For this reason the use of anode bags is not recommended for the 95/97% nickel anodes.

People who use these 95/97% anodes say that they do a good job and do not cost as much as the rolled depolarized. A careful examination of a number of installations of these anodes show that they are doing a very good job, indeed.

There is an important point that should be made here and that is that the cast 95/97% and the rolled depolarized nickel anodes are designed for use in dull plating high pH nickel baths of the Watts type. Both anodes will exhibit good corrosion in such baths. The cast and rolled low carbon type of nickel anodes, on the other hand, are designed for use in baths of lower pH. Sometimes they are mistakenly put into high pH baths and then the anode corrosion is not good.

Four small anodes were run in the laboratory in identical Watts baths contained in large beakers. The temperature was held at 110 to 120°F. and the beakers were connected in series. In this way the same current passed through each anode. The pH of all four solutions was kept at about 5.2 electrometric and, after 19 full days' electrolysis, the anodes were removed and inspected. The rolled depolarized nickel anode came down beautifully and the cast 95/97% also showed nice corrosion. The cast low carbon anode and especially the rolled low carbon anode showed rough irregular areas on the edges and large pit holes on the surface. These last two anodes do not exhibit good anode corrosion in high pH nickel baths and, therefore, should never be used in this type of solution.

By far the largest tonnage of nickel anodes in Canada is used in bright nickel solutions and, for this type of bath with a low or medium pH, the cast or rolled low carbon anodes both give beautiful results and are the only types of anodes that should be used.

In discussing these anodes, attention is directed to Table IX where typical analyses of all four types of nickel anodes are given. It will be noted that these analyses fail to disclose any significant difference between the cast and rolled low carbon types of nickel anodes. This means that one can be sure that with either anode there will be no danger of harmful impurities entering the plating bath. This has also been proven during the past many years through the fact that many thousands of tons of both types of anodes have been successfully used in bright nickel plating. No case of metallic impurities being introduced into the plating bath through either type of anode is on record.

When we look at the two anodes a difference is at once noticeable. The rolling process gives the rolled anode a smoother, more uniform appearance. Also, the two anodes differ as to cross-section area, the cast being the larger and weighing 1¼ to 1½ pounds per

TABLE IX

Typical Analysis of Nickel Anodes

	Cast 95-97% %	Cast Low Carbon %	Rolled Low Carbon %	Rolled Depolarized %
Nickel & Cobalt	98.17	99.32	99.40	99.60
Oxygen	Nil	Nil	Nil	.18
Carbon	1.09	.28	.23	Nil
Copper	Nil	.014	.04	.045
Iron	.01	.04	.05	.05
Manganese	.12	.08	.001	*
Sulphur	.16	.015	.009	.005
Silicon	.45	.33	.200	.01
Magnesium	*	.08	.045	*

*Information not given.

inch of length as against 1 pound per inch of length for the rolled.

Much can be learned about the characteristics of nickel anodes by examining anode scrap from production tanks. During these past few years of nickel shortage we have received from customers many tons of nickel anode scrap for remelting and time and again the writer has spent hours examining scrap from both cast and rolled low carbon nickel anodes. We have run laboratory tests, too, under controlled conditions and these have given us a lot of information but we still prefer to base conclusions on the examination of used anodes that have come out of operating tanks all over the country. They tell a complete story. For example, a study of used nickel anodes shows that they dissolve more smoothly at high current densities than at low. This can best be discovered by examining anode scrap that has come from anodes that have been hung up against the tank wall. Such anodes can easily be spotted by their shape. Very little nickel has been removed from the back side because the current density has been so low. On this side the surface is nearly always rough and pitted and this applies both to cast and rolled anodes. Anode scrap that comes from the center rod of a tank is always smooth on both sides because it takes a high current density.

We like to see smooth corrosion of nickel anodes and, when the current density is high, we will get smooth corrosion with either cast or rolled low carbon type nickel anodes. Actually, however, if the surface is slightly rough because of low anode current densities, no harm is likely to result. As the anode dissolves a slimy layer of carbon and silicic acid is formed and this layer holds any loose nickel particles until they have completely dissolved. The carbon-silicic slime and the anode bag itself form complete protection against metallic particles entering the bath proper and causing rough plate.

Summing up this discussion of cast and rolled low carbon nickel anodes, it can be said that:

(1) The analysis of either type of anode as made by reputable manufacturers can be accepted as safe for use in bright nickel plating baths. No harmful metallic impurities will be introduced.

(2) Both anodes dissolve smoothly except under conditions of low anode current density where a certain amount of roughness of the anode surface is encountered.

Both anodes are entirely satisfactory for use in bright nickel baths.

Now to discuss some special points that should be considered in the selection and use of anodes. These remarks are not specific to any particular metal or type of anode but are of a more general nature.

Selection of Anode Length

One anode problem that is encountered every now and then is the dissolving through of the anode at the middle or even higher up. This permits the bottom part of the anode to fall to the bottom of the tank and, of course, is very wasteful as it produces much more anode scrap than necessary.

If the anode is too long and hangs down lower in the bath than the work, the bulk of the current following the course of least resistance will be drawn from that part of the anode that is directly opposite the work. Under these conditions very little dissolving takes place at the lower part of the anode and excessive anode scrap results.

That is not all — what current is drawn by the lower part of the anode goes to the bottom of the work which is already a high current density point. The result is poor plate distribution with the possibility of burning at the bottom of the work.

Under ideal conditions the bottom of the anode will hang about 2″ above the bottom of the work. This condition not only tends to lower the current density at the bottom of the work and produce better plate distribution, but it makes the anode current density highest at the very bottom. The anode therefore dissolves faster at the bottom than further up and the formation of anode "clubs" is impossible.

This rule would be easy to apply if all the racks handled in any given tank were of the same dimensions. Unfortunately, most plating tanks have to handle racks of varying lengths and here the temptation is to choose an anode length that will suit the deepest work. If there is much variation in work length, it is better to alternate short and long anodes. When shallow work is being plated the current is drawn from the anode area opposite the work, that is from the short anodes and from the top part of the long anodes. When deep work is being plated, an extra heavy current is drawn from the relatively small number of long ends that project down and they should, therefore, dissolve at about double the normal rate. Thus, the formation of "club" type scrap is eliminated.

Hook Length of Anodes

Here we must distinguish between acid and alkaline plating baths. In acid baths such as nickel, acid copper and chromium, the anode hook must be kept above the solution level as otherwise it would dissolve, contaminating the bath and possibly allowing the anode to drop to the bottom of the tank. Also, the hook must be made of Monel metal or some similar alloy that will resist corrosion by acid fumes and spray. The length of the anode hook measured from the top inside of the hook to the anode proper should be such as to leave the top of the anode about 1″ above the highest level of the solution. This will minimize anode scrap.

In dealing with alkaline plating solutions such as copper, zinc, cadmium or tin, the problem is entirely different. Here steel is the ideal hook material since it is cheap and is not attacked either chemically or electrochemically by the solution. To minimize anode scrap the top of the anodes should be kept under the solution at all times. Hooks should, therefore, be made long enough to bring about this result.

This is particularly important in high speed copper plating because insoluble copper compounds will form at, or just above, the solution line if anodes are allowed to project out of the solution. Then when the level of the bath is raised to replace evaporation losses, the insoluble copper compounds are washed into the plating bath where they may cause roughness. Special spring type steel hooks are available for copper anodes.

Insoluble Anode Surface

If one makes use in his plant of zinc or cadmium ball anodes, chances are that he has as much as one-third insoluble anode area in his tanks. We are referring, of course, to the steel cages that hold the ball anodes. Perhaps some have wondered about this steel anode surface. They might ask: "How can the metal content of the bath be maintained with so much insoluble anode area?" One might also wonder whether or not oxygen gas is generated at the steel anode surface and, if so, does this oxygen have the effect of decomposing sodium cyanide by oxidization. These are important questions and let us see if we can find the answers.

Let us take a look at the principles governing the flow of current in an electrolytic cell but first we should consider a simpler conducting path — a piece of resistance wire connected across the bus bars.

The resistance to the flow of current is simply the resistance of the wire connecting the positive to the negative bar. As long as there is any difference in potential or voltage between the bars, some current will flow through the wire. The magnitude of the current will depend upon the voltage applied and on the resistance of the wire; when we turn from this example to the conditions existing in a plating bath, we run into a couple of complications.

Here our conducting bath is a solution of chemicals instead of a length of wire. Now the mechanism by which chemical solutions conduct an electric current is such that a change in the composition of the solution must take place at each electrode. This change requires electrical energy and for each type of chemical change a definite voltage is required which will vary depending upon the conditions. At the work or cathode surface the solution is decomposed and metal sometimes accompanied by hydrogen gas is deposited. The voltage or potential required to accomplish this is called "cathode decomposition voltage" and is measured in volts. Similarly, at the anode the anode decomposition voltage is measured in volts and is the voltage necessary to force metal into solution.

The total voltage across the tank as measured by the voltmeter consists of the anode decomposition voltage plus the cathode decomposition voltage, plus the voltage required to pass the current through the conducting bath. If we were to start from zero and gradually raise the voltage across the tank by small fractions of a volt, we would notice that no continuous current would flow until the sum of the anode and cathode decomposition voltages had been provided for.

Now, in the case of an insoluble anode, such as steel in an alkaline plating solution, the chemical change taking place requires decomposition of the water in the bath with the formation of oxygen gas. This type of chemical change requires a much higher decomposition voltage than is required to dissolve zinc or cadmium metal. So high is it, in fact, that it can be safely said that no current passes through the steel anode unless the soluble anode is polarized.

If the current density on a cadmium or zinc anode is gradually increased by raising the voltage gradually, a point is finally reached at which the current falls with further small increases in voltage. A very large increase in voltage is necessary in order to increase the current. At this point the color of the anode changes to black due to the formation of a film and the anode is said to be polarized. When this happens it then becomes possible for the insoluble anode surface to transmit current to the solution.

Two experiments, one with cadmium and steel, the other with zinc and steel anodes were carried out in the C. H. & V. W. laboratory.

A cadmium and a steel anode of identical area were placed side by side at one end of a rectangular glass tank in the laboratory with a steel cathode at the other end. The tank contained a cadmium solution. The electrical connection to the anode was split so that the current supplied from each anode could be measured separately. The line voltage was gradually raised with the results shown in Table X.

In this experiment, polarization of the cadmium anode was noticed at 40 amperes per square foot when the anode first turned bright and then black. Only then did current commence flowing from the steel surface. Thus, as long as there is plenty of cadmium anode surface in the tank so that the current densities that cause extreme polarization are not reached, no appreciable current enters the solution through the steel cages. If cadmium anodes turn black, one should in-

(*Concluded on page 71*)

TABLE X

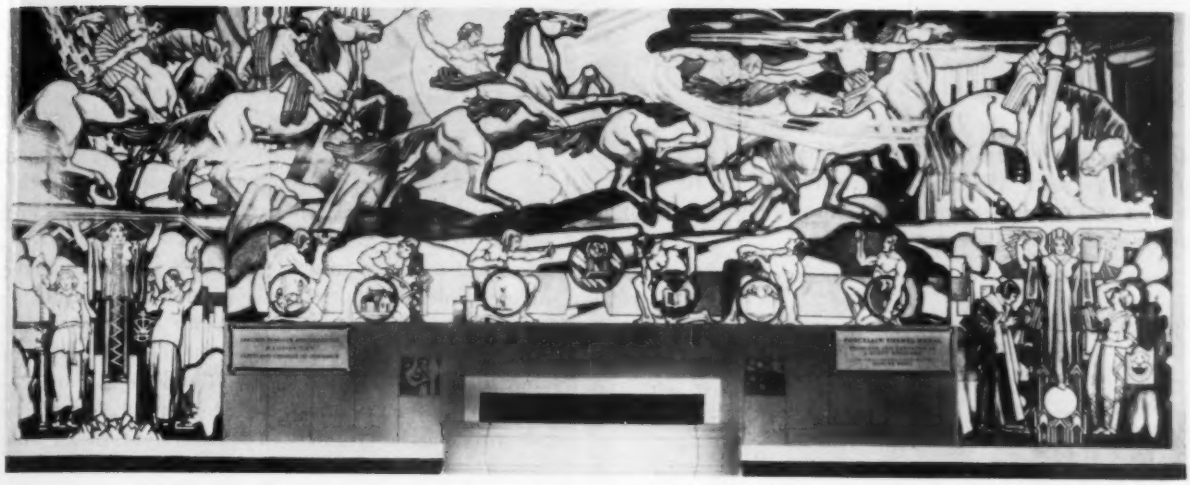
Distribution of Current Between Cadmium and Insoluble Anodes

Current Density on Cadmium Anode amp./ft.^{2}	Current Density on Steel Anode amp./ft.^{2}	Line Voltage V.
5	—	0.25
10	—	0.30
15	—	0.82
20	—	1.20
25	—	1.40
30	—	1.80
35	—	2.20
40	6	3.10
45	17	4.10
50	28	4.70

TABLE XI

Distribution of Current Between Zinc and Insoluble Anodes

Curent Density on Zinc Anode amp./ft.^{2}	Current Density on Steel Anode amp./ft.^{2}	Line Voltage V.
5	—	0.28
10	—	0.42
15	—	0.60
20	—	0.78
25	—	1.00
30	—	1.20
35	—	1.35
40	—	1.55
45	—	1.65
50	—	1.80
51	—	2.75
71.5	96	6.1



(Courtesy Porcelain Enamel Institute, Wash., D. C.)

View of porcelain enamel on steel mural at the Cleveland Union Terminal depicting man's struggle against the elements.

Porcelain Enamel: Orphan of the Metal Finishing Industry

By Eugene M. Smith, *Metallurgical Engineer, Youngstown, Ohio*

Introduction

IT is strange that the most spectacular of metal protective coatings is so common that few recognize it when they see it. When attention is directed to glass-coated steel, the reaction is always one of amazement, if not incredibility. Its existence is not convincing and no consumer can accustom himself to handling a porcelain enameled article as if it were glass as it truly is.

Corrosion engineers and product designers are constantly on the alert for a material having excellent corrosion resistance in intermediate temperature ranges, say up to 1400°F. Although they cook in it, eat from it, and bathe in it, the material they are looking for remains little known and slightly applied.

By combining the chemical endurance of glass with the high strength, low cost of steel, a versatile material is available to the metal fabricator at a substantial saving in cost. Outstanding characteristics contributing to the utility of porcelain enameled coatings are appearance and service life. Glass coatings may be either clear or any color in the spectrum, not excluding black. Since it is glass, vitreous enamels have all the attributes of glass such as permanence, smoothness, hardness, scratch resistance and insolubility in common liquids excepting hot strong caustics and hydrofluoric acid.

Glass coatings are applied most commonly to cast iron, low carbon steels, and to an especially low carbon steel called enameling iron. For decorative purposes such as artistic endeavors, coatings are applied to copper, silver and gold, or any other metal which can withstand the fusion temperature of the glass. Benvenuto Cellini, as early as the 16th century, enhanced his reputation as an illustrious artisan by using porcelain for making fine jewelry. Yet, even then, enameling was an ancient process. Enameled articles have been found and dated as made in the Byzantine period early in the Christian era.

Although ancient in the art of the metal protecting and decorating industry, porcelain enameling is only on the threshold of an adventurous growth. Production of porcelain enameled steel products is relatively simple. A finely ground glass, either dry or a wet slip, is applied to a clear, scale-free steel of selected analysis and fired to fusion temperature. Upon cooling to room temperature, the product is ready for use unless the procedure is repeated when a second, more decorative coat is desired.

Products coated with glass range in size from toggle switches to beer vats and silos. In application, porcelain enameled products are found in the kitchen as well as in heavy industrial plants. Its versatile utility is based on price of competitive corrosion resistant materials and customer appeal resulting from attractive appearance.

Peculiarly, the very simplicity of applying glass coatings to steel may explain the anonymity of the product and may be responsible for restricting its more widespread use. There is no integrated producer interested in expanding the market. Most enameling shops are relatively small, many are family concerns, and enameling is incidental to the production or the product. The small size of the enameling concern restricts advertising budgets. The industry is highly competitive pricewise; hence, there is a tendency to protect with secrecy the improvements in processing techniques. However, in recent years technical knowledge is becoming more readily available. In sales promotion as, for example, with electric or gas ranges, features are stressed other than the fact that porcelain enamel coating is used.

Steels used for fabricating the product come from one group of suppliers, glass comes from a second

group, and service performance and pricing is the responsibility of a third group.

Enameling Steels

Enamel iron is the usual base material when porcelain enameling formed sheets. Enamel iron, as contrasted to steel sheets, is characterized by the low carbon and residual metallic element contents as shown in Table 1.

TABLE I.

Typical Ladle Analysis of Steel and Iron Used For Porcelain Enameling in Per Cent

	C	*Mn*	*P*	*S*	*Al*
Enameling Iron	.03	.04	.01	.03	—
Rimmed Mild Steel	.08	.35	.015	.03	—
Killed Mild Steel	.06	.35	.01	.03	.05
Titanium Stabilized Steel	.05	.30	.01	.03	.30 Ti .10 Si

When making such iron, it is necessary to select the raw materials more carefully to assure that contaminants are kept out. Steelmaking practices are more exacting. Refining temperatures are higher, and furnace refractory wear is thus greater. To remove carbon to the desired low level requires a longer time in the open hearth. Sometimes a particular heat or portions of the heat must be discarded and diverted to other uses; hence, losses are greater than normal. Processing during rolling is somewhat more exacting and demands special supervision and inspection to assure special surface requirements. Normalizing, followed by pickling and scrubbing, adds to the cost of production. As might be exepected, more extensive testing is required in producing a specialty product. In turn, the quality received by the customers is more uniform. Hence, enamel iron is more costly than cold rolled steel.

Low carbon iron is advantageous in vitreous enameling. First, the chemical decomposition of carbon or moisture in the frit forms gas during the firing operation which tends to cause defects classified as fish scales and copperheads. Such defects may be obvious shortly after cooling to room temperature or be delayed for a considerable time (one week or months). In appearance, fish scaling is a popping off of a small halfmoon shaped chip, thin on one edge and thick on the other. Hence, carbon steel stabilized with titanium is used to avoid this type of defect. Copperhead is an area over-oxidized when exposed to the atmosphere during violent evolution of gas. Second, enamel iron has high resistance to warping and sagging at firing temperatures. Not only does the low carbon and manganese content contribute to the dimensional stability at firing temperatures, but the absence of a transformation below 1600°F. assures retention of shape during the firing operation.

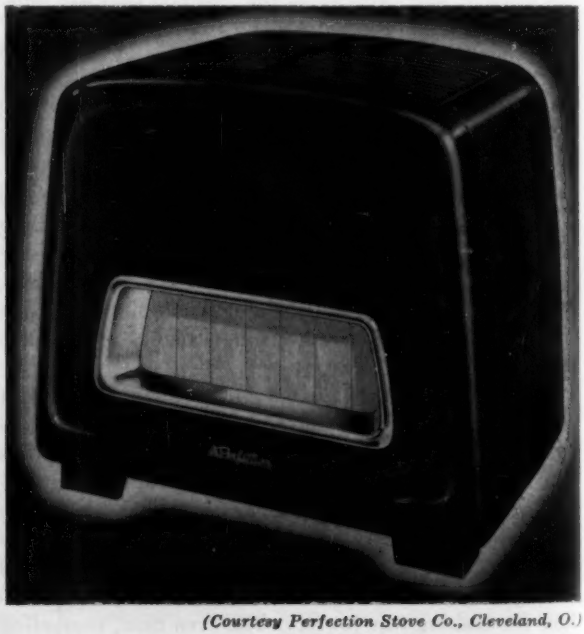
However, drawing quality enamling iron is somewhat inferior to mild steel for deep drawing applications. Tensile and yield strength and ductility compares unfavorably with mild steel. However, relatively severe draws, as illustrated by washing machine tubs, are made commonly.

The development of enameling iron replacing cold rolled steel during World War I was an impetus to the enameling industry. However, further improvement in base material is desired. There are still too many instances when multiple coats are required to mend defects. White enamels cannot be applied directly to enamel iron. The enamel ground coat contains cobalt which is scarce. A pre-dip in a nickel solution, although severely restricted during war emergency, is sometimes employed to improve adhesion. During World War II, these material restrictions directed attention to eliminating the use of these strategic materials.

Development work was directed to stabilizing the carbon by addition of titanium, chemical treatment of the surface to minimize the effect of carbon, and elimination of carbon from the steel surface by wet hydrogen annealing. Each of these methods shows

(Courtesy Ronson Art Metal Works, Inc., Newark, N. J.)

The "Minerva" white porcelain Ronson cigarette lighter.



(Courtesy Perfection Stove Co., Cleveland, O.)

Gas heater with porcelain-enameled grill.

(Courtesy Porcelain Enamel Institute, Wash., D. C.)
Porcelain enameled cocktail tables.

(Courtesy Seaporcel Metals, Inc., New York)
Prefit handrail with flush surface and porcelain enamel finish.

much promise in performance but adds to the cost of producing steel. As a result, with the passing of the wartime shortages enamel iron again is in an unassailable competitive position. Commercially only the titanium containing steel is still available. Nevertheless, development work has not been abandoned as the need for improvements remains and awaits only the discovery of a suitable procedure.

Statistics of Iron and Steel Institute indicate that annual production of enameling sheets approximates 300,000 tons.

Preparation of Steel and Enameling

Most enameling is done on fabricated parts, washing machines, refrigerator liners, etc. Hence, the steel is prepared for coating by removing drawing compounds, in an aqueous degreasing tank. Following cleaning, the metal is pickled to remove rust or stains. Then some processors nickel-dip the prepared steel.

A flash coating of nickel widens the firing range for ground coats. Further, it is believed commonly that the use of nickel contributes to better adhesion. Nickel deposits approximate 0.05 to 0.07 grams per square foot of surface.

Enamel Materials

Enamelers depend upon the frit makers to prepare and supply material suitable for the product. Enamel material is commonly classified according to use; iron or steel enamels, dry process cast iron enamels, wet process cast iron enamels, and jewelry enamels. Enamel compositions are complex and are designed to meet particular service requirements.

Hence, it is found that enamel producers work very closely with the enameler so that composition can be adjusted to meet specific objectives. For example, ground coats may be either the usual blue cobalt type or modified to provide a lighter color. White cover coats may be either hard or soft, acid resisting, or super opaque. Colored top coats may be glazes, colored frits, black beading or edging enamels, graining enamels, or mottled enamels.

GROUND COATS:

Presence of cobalt oxide is characteristic of most ground coats. The cheaper oxides of nickel and manganese are frequently used as a diluent. Cobalt oxide contributes adhesion of the enamel to the steel but its natural intense blue color limits color choice. In general, ground coat enamels are less complex than cover coat compositions. Feldspar, borax and quartz account for 75% to 85% of the ingredients in ground coats. The remainder is soda ash, sodium nitrate and fluorspar.

COVER COATS:

In addition to the constituents previously mentioned as present in ground coats, cover coats contain small amounts of antimony oxide, zinc oxide, titanium dioxide, whiting, barium carbonate, magnesium carbonate, clay and pigment to provide the desired color. The enameler most generally depends upon the frit maker to prepare and supply a material suitable for the market. Hence, it is not necessary to burden ourselves with the making of frit or the myriad compositions of cover coats.

Enameling

An enamel slip is made by milling the as-received frit with opacifiers, colors, suspending agents such as clay, and electrolytes. Slip is prepared so it has a high mobility for free flowing and quick draining and proper consistency to prevent premature settling and a preferred rate of set.

Steel is coated with slip by a spray or dip process. When slush coating, the steel product is immersed in a tank of slip and afterward is drained on a rack suspended above the dip tank. Spray coating is similar to paint spraying. Equipment for spraying consists of the atomizing gun, a receptacle for the slip and a spray booth. Slip is supplied to the gun either by gravity from an overhead tank or by air pressure. Coating thickness of 3 to 6 mills are typical.

After coating with the slip, the article is dried in 3 to 5 minutes. Drying can be done by radiant heating. Conveyor ovens operating at 300-400°F. are most common. Drying is followed by fusion of the slip by firing in a furnace for 1 to 4 minutes at a temperature of 1500-1600°F. The top or cover coat is applied in

a similar manner but the firing temperature is slightly less than that used for the ground coat.

Thus, it is evident that enameling is no more complicated than painting. At the same time, it is evident that the equipment and knowledge for doing the work is somewhat specialized. Hence, substitute coatings, even though they are not so satisfactory, are many times first in the minds of the designers.

Applications

The use of porcelain enameled steel is much more widespread than commonly recognized. Its versatility is evidenced by its numerous applications.

The home appliance industry makes use of the customer appeal associated with excellent appearance. Kitchen ranges, laundry equipment, and refrigerators typify appliances that are large consumers of vitreous enameled steel. The electrical resistivity of the glass coating is a safety feature in electrical equipment and has been useful in the design of insulators.

An excellent example of the use of porcelain enamel in the architectural field is the ill-fated Lustron house. Similarly, gasoline service stations and restaurants benefit from the ease in keeping porcelain enamel clean. The building trade has grossly neglected enameled steels, although many products are being used presently. Bathroom and kitchen tile, store fronts and lobbies are included among common present uses. Potential uses are window sills, temporary partitions, roof tiles and flashing.

In the chemical industry, porcelain enamel ware is used if contamination is to be avoided or if corrosive environments are troublesome. Vitreous enamel is the only non-metallic coating for steel that can be heated with direct flame without harm in the temperature range of 600 to 1200°F. Food processors generally have used enamel cooking ware for years. Only enamel ware can provide the many color schemes demanded by many modern kitchen decorators.

A rapidly expanding use for the heat resisting and scaling resisting qualities of porcelain enameled coatings is in the aircraft industry. The jet engine program makes much use of enameled steels. Propeller-driven B-29's are becoming obsolete as a result of progress in jet engine design. Porcelain enameled pipe has been found useful for degassing molten aluminum and suggests its use for lining lead pots and prolonging the life of thermocouple protection tubes.

Future Developments

It is anticipated that the use of porcelain enameled steel will continue to expand in the fields it now occupies. As material engineers become better alerted to the outstanding qualities of this rather unpromoted material, present uses may appear relatively small-scale. For example, use of porcelain enameled steel in the transportation industry is hardly evident. Yet the necessity for repainting and cleaning of railroad and truck conveyances would justify consideration of enameled surfaces.

An item as common as the corner mail box would be practically maintenance free if coated with porcelain. Just recently the post office department announced with pride that newly developed paints would now permit repainting every three years instead of annually. Similarly, boulevard light standards would benefit in appearance if made from enameled steel.

(Courtesy Style Metal Specialties, Inc., New York)

Example of costume jewelry, background filled with colored porcelain enamel.

Building siding and roofing, both industrial and agricultural, if porcelain enameled, would provide low upkeep cost. Interior of public buildings would benefit if artists were more familiar with porcelain enameling as an artistic media. Travelers passing through Cleveland Tower Terminal admire the beauty without recognizing the fact that the mural gracing one major wall is porcelain enamel.

The major constituents used in making porcelain enameled steels are abundant and come from domestic sources. Hence, except for cobalt and the infinitesimal amount of nickel used in the predip, enameled steel can contribute to the conservation of the strategic metals, chromium and nickel, during international emergencies.

If one coat white porcelain enamels are successfully developed, the costs of production can be decreased. With a lower selling price, the great metal consuming industries will be forced into evaluation of porcelain enameled steel as a cheap, durable, attractive coating for steel products.

ANODES FOR ELECTROPLATING

(*Concluded from page* 70)

crease the anode surface in the tank until they become dull again. If this rule is followed current will not be drawn from the steel cages and one should, therefore, in the absence of excessive dragout, be able to maintain the metal content of the solution fairly well. Also, cyanide decomposition will be kept at a minimum. This is one more way in which waste can be eliminated by the intelligent use of anodes.

Another series of experiments in which a zinc anode and a zinc solution replaced cadmium yielded the results shown in Table XI.

Zinc anodes react similarly to cadmium and as long as anode area is kept well up, no current will be drawn from the steel surface.

Credit is due to *Douglas Hanna, Rose Moores* and *William Finn* of the *Canadian Hanson & Van Winkle Co. Ltd.* technical staff for the experimental work reported above.

Metallizing of Glass, Ceramic and Plastic Surfaces

By R. J. Heritage and J. R. Balmer, *Telecommunications Research Establishment, Great Malvern*

In recent years, there has been a growth in interest in the coating of glass, ceramics and plastics with films of metal. Besides decorative possibilities, there are a number of industrially important applications in the electrical and optical fields. Three important techniques are discussed, namely, reduction from aqueous solutions; reduction by heat; and evaporation in a vacuum.

THE term "metallizing" implies the coating of a surface, wholly or in part, with a metal layer, to confer on it desirable chemical and physical properties. In recent years, interest in the many uses of the metallizing processes has increased and, in addition to decorative possibilities, various industrial and scientific applications have been found. These include the coating of mica and plastic materials with silver for condensers, silver or aluminum deposits on glass surfaces for optical and thermal reflectors, as well as the use of metal films for resistors, conductors and rectifiers. In addition to the older well-known methods, alternative and more efficient processes have been found, and the art has now become a reliable and effective tool for commercial applications.

In this account, three metallizing techniques are described, namely, reduction from aqueous solutions, reduction by heat, and the evaporation of metals in a vacuum; this is followed by a comparison of the methods and a survey of their uses. Throughout the text, references to other works are quoted to enable the reader to explore the subject more fully than present space permits.

Reduction from Aqueous Solutions

The success of this method depends to a great extent on the freedom of the surface from grease. Many degreasing solvents are available but the choice must depend on the particular material under process. Glass and ceramic materials may be very efficiently degreased with caustic alkalis followed by nitric acid, but for plastics, organic reagents or mild alkalis which do not attack them must be used.

After this preliminary degreasing, the surface is often activated by immersion for some few minutes in a suitable solution. The agent commonly used for this activation is an acid solution of stannous chloride, of which the most suitable concentration is about 10%. Other agents used for the same purpose include a 2% aqueous solution of pyrogallol or hydroquinone, or ammoniacal ferrous sulphate solution.

SILVERING PROCESS:

In general, these methods involve the reduction of a silver complex by a suitable reagent in solution. The preference for a particular method is a matter of personal choice; the examples listed below are equally applicable to glass, ceramic or plastic materials.

(a) Cane Sugar Reduction.—The silvering solution is made up as follows:

2 g. of silver nitrate are dissolved in 200 ml. of distilled water, and to this a 20% ammonia solution is slowly added, with stirring, until the brown precipitate redissolves; 10 ml. of 10% potassium-hydroxide solution are then added, followed by ammonia until the solution remains faintly turbid, after which the whole is filtered.

The reducing solution, which is composed of:

Cane sugar	100 g.
Nitric acid	5 ml.
Ethyl alcohol	200 ml.
Water	1,000 ml.

should be kept in a dark bottle for two weeks before using.

In use, 10 ml. of reducing solution is added to each 20 ml. of ammoniacal silver solution. It is convenient to cool the solutions before mixing, as this prevents too rapid a reduction, which would result in much silver being wasted in the form of powder.

(b) Formaldehyde—Rochelle Salt Reduction.—This method, which is a combination of two well-known methods, has been used by the authors for deposits of greatest adhesion. Following an activation in stannous chloride solution, the material is immersed for a few minutes in a mixture of 3 volumes of methyl alcohol and 7 volumes of formalin (40% formaldehyde solution). For silvering on glass surfaces, a small addition

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of 10% stannous chloride solution to the mixture is found to be an advantage. After thoroughly washing the surface in distilled water, the material is immersed in the silvering solution, made up as follows:

(i) 30 g. silver nitrate are dissolved in 300 ml. distilled water and ammonium hydroxide is added until the brown precipitate first formed redissolves (the solution should smell slightly of ammonia); the volume is then made up to 600 ml. with distilled water.

(ii) 30 g. Rochelle salt (sodium potassium tartrate) are dissolved in 400 ml. distilled water.

Solutions (i) and (ii) are filtered, and mixed immediately before use. Normal silvering should take from 20 to 30 minutes, but as much as one hour may be allowed for a thicker deposit. In general the longer the immersion period the less adherent is the deposit.

(c) Hydrazine Sulphate Reduction.—This method is suitable for ceramic, glass and plastic bases. The material is degreased and activated in 10% stannous chloride solution. After washing in water, it is immersed in a 2% solution of silver nitrate in distilled water until a faint brown color is acquired. The surface is then washed with water and covered with the following mixture until the required thickness of silver is obtained.

(i) 70 ml. ammoniacal 1% silver nitrate solution.

(ii) 10 ml. pyridine, 16 ml. of 1.25% hydrazine sulphate solution.

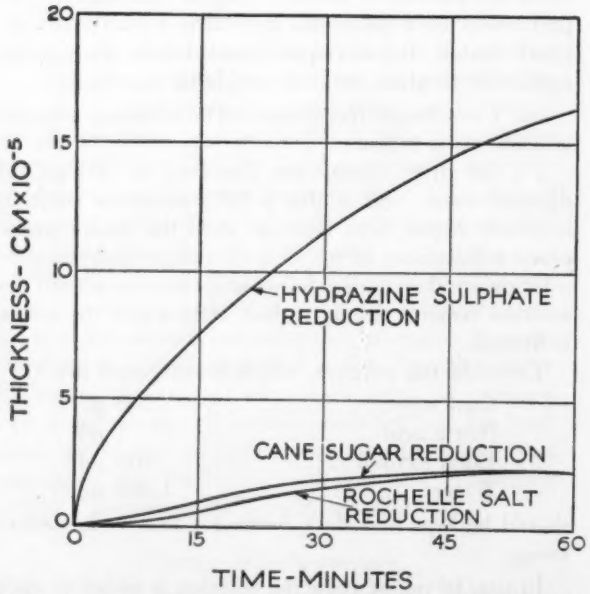

Figure 1. Rate of deposition of silver on glass by various methods.

Solutions (i) and (ii) are mixed immediately before using. The pyridine retards the reduction of silver and more or less than the specified amount may be used.

An interesting modification[1] of this process is the application of silver solution and reducing agent to the surface to be coated by means of fine sprays directed from separate nozzles, thereby economizing in the use of silver.

In comparing the three silvering processes outlined, it may be stated that as far as the adhesion and fineness of the deposit is concerned the Rochelle salt reduction gives the best results, but the efficiency of the solution is far less than the other two methods. The Rochelle salt process is ideal for coating plastic, ceramic or glass surfaces prior to electrodeposition, when adhesion and not thickness of the film is the criterion; it is also suitable for producing very thin films for use as half-silvered mirrors in optical instruments.

The rate of deposition of silver by the three methods is compared in Figure 1. Although deposition may be continued for longer periods than those shown, the films tend to become loose after too long a period, and after one hour most of the silver is precipitated as a powder.

METALS OTHER THAN SILVER:

Copper Mirrors.—After activation with stannous chloride solution, ceramic, glass or plastic surfaces may be coated with copper by immersion in the following mixture:

Copper sulphate	5 g.
Water	200 ml.
Ammonium hydroxide	20 ml.

and

Rongalite (sodium formaldehyde sulphoxylate)	5 g.
Water	100 ml.

A second method recommended by M. Volmer[2] uses the following solution:

Copper sulphate	4 g.
Sodium hydroxide	7 g.
Rochelle salt	18 g.
Potassium sulphate	10 g.
Water	1 liter
Formalin solution	15 ml.

The surface to be coated should bear a very thin film of gold before immersion in the metallizing solution, and this is readily effected by a dip in 1% gold chloride solution immediately after activation with stannous chloride solution.

Gold Mirrors.—A very satisfactory method for depositing gold mirrors uses the following solutions after activation as above:

(i)	Gold chloride	1 g.
	Water	250 ml.
(ii)	Potassium carbonate	8 g.
	Sucrose	1 g.
	Formalin	1 ml.
	Water	250 ml.

Equal parts of (i) and (ii) are mixed before use. This method can be used for glass and plastic surfaces, but it has been found that prolonged immersion causes stripping of the gold deposits.

Antimony Mirrors.—A method for producing bright antimony mirrors[3] relies on the reduction of antimony trichloride by tartaric acid and formaldehyde. For success in this method the surface to be mirrored should bear a very thin film of gold.

Alloy Mirrors.—Methods for producing alloy mirrors have been devised, and in particular silver alloys may be readily obtained by reduction of mixed solutions of silver and other metal salts. Silver-copper alloy mirrors are produced by reducing mixed solutions of the metal salts with Rochelle salt and tartaric acid, or with formaldehyde.[4,5] A patent by A. Rost[6] gives a method for obtaining a platinum-silver mirror while

another patent by Ermes[7] details a solution which gives an alloy mirror of silver, copper, nickel, zinc and chromium. The mirror is reputed to be extremely hard and resistant to corrosion. A large number of references to metallizing methods is included in a paper by B. P. Upton[8] which deals with reduction from aqueous solutions.

Firing Methods

These methods usually depend on the reduction of metal compounds by heat. This fact limits the use of the methods to base materials which are capable of withstanding high temperatures, and to metals whose compounds are reducible by heating. It is well known that salts of the so-called noble metals decompose at elevated temperatures, and of these, platinum, gold, palladium and silver are commonly used in metallizing solutions for firing on glass and ceramic bases.

The solutions indicated below are readily made up in the laboratory and they have been found to yield satisfactory films on both glass and ceramics.

SILVER:

Metallic paints for silver usually comprise finely divided silver and a flux in a suitable oil medium. The flux often used is lead borate, and a typical formulation is:

Silver powder	2 g.
Lead borate	1 g.

These are mixed to a paint-like consistency with lavender oil, or rosemary oil and, after application, the suspension is dried and fired.

Greater adhesion is obtained by incorporating a fluoride in the flux and an example of this type of mixture is:

Silver powder	60 g.
Lead borate	3 g.
Bismuth nitrate	1.5 g.
Lead fluoride	5.5 g.
Lavender oil	30 g.

The paint is suitably applied to a glass or ceramic base and fired at about 650°C.

GOLD:

Gold films may be obtained from solution of a similar composition to those for silver, but the gold powder used should be very finely divided. A suitable flux consists of:

Bismuth nitrate	12 g.
Sodium borate	1 g.

This is mixed with the gold in the proportions:

Gold	10 g.
Flux	1 g.

Another simple metallizing solution for gold is made by mixing gold chloride with a small amount of rosemary oil and diluting the resulting paste with lavender oil; the solution is then fired at about 600°C. in an oxidizing atmosphere. A further method for producing gold films which requires only moderate heating has been described by Gibson.[9]

PLATINUM:

Glass or ceramic surfaces may be platinized by the reduction of platinum chloride solution by heat. The solution is made by mixing dry platinic chloride with rosemary oil until the consistency is that of a thick paste. If the solution is to be used to provide a base for soldering, it may be used as such, but if it is for mirroring it should be diluted with rosemary or lavender oil. The solution is applied, allowed to dry and then heated to about 650°C.; for glass surfaces, the temperature should be raised to the softening range to obtain greatest adhesion. This process may be applied to ceramic, mica, and quartz as well as platinum and nickel surfaces; the thicker mirrors can be used as a base for soft soldering.

As in the case of silver and gold, greater adhesion may be obtained by the addition to the platinizing solution of a suitable flux; boric acid, lead borate, and bismuth chloride are commonly used fluxes.

A typical example of a solution with flux additions is:

Platinum chloride	5 g.
Lead oxide	0.1 g.
Lead borate	0.1 g.
Lavender oil	10 g.

It is applied to glass or china and heated to 650°C.

OTHER METALS:

Chlorides of palladium, rhodium, ruthenium and iridium may be substituted in the examples above for platinum chloride, while examples of other solutions are to be found in the patent literature.[10,11] A process for coating osmium on both metallic and non-metallic bodies has been described,[12] while a further method[13] covers other platinum metals.

Evaporation

Essentially, evaporation as applied to metallizing processes, consists of heating a metal in a high vacuum until its vapor pressure exceeds 10^{-2} mm. of mercury. In practice, a small amount of the metal is heated (usually electrically) on a tungsten wire or spiral and, as it vaporizes, molecular rays are emitted in all directions; the vacuum required is of the order of 10^{-5} mm. of mercury.

Some values for the evaporation temperature, defined as the temperature at which the vapor pressure of the metal reaches 10^{-2} mm. of mercury, are given in the table below.

Table 1

Evaporation Temperatures of Various Elements

Metal	*Temperature ° C.*	*Metal*	*Temperature ° C.*
Cadmium	268	Silver	1,045
Zinc	351	Gold	1,173
Magnesium	440	Aluminum	1,188
Calcium	606	Copper	1,270
Barium	632	Iron	1,420
Bismuth	640	Nickel	1,444
Antimony	700	Platinum	2,059
Lead	728	Molybdenum	2,481
Tin	876	Carbon	2,522
Chromium	917	Tungsten	3,232

The choice of heater material and its form depends upon the metal to be evaporated: for instance, aluminum may be evaporated from a loop of tungsten wire

since, on melting, the metal wets the tungsten and adheres to it, but silver and gold are best evaporated from a small tungsten boat or a conical basket. Detailed comparisons of various heater forms are described in an article by Olsen, Smith and Crittenden.[14] Other useful data on evaporation are given by J. Strong,[15] and Dushman.[16]

Electrodeposition on Metallized Coatings

It is often desirable to thicken the films produced by metallizing, and for this purpose numerous electroplating solutions have been developed. To prevent chemical attack on the initially thin films, the usual practice is to begin deposition from a special bath and then to transfer to the normal plating bath for building up. It is advisable however, to electroplate as soon as possible after metallizing, otherwise the surface may become contaminated with films of oxide or sulphide and poor adhesion will result.

For thickening silver films the following bath has been found most satisfactory:

Silver nitrate	25 g.
Sodium cyanide	28 g.
Potassium nitrate	100 g.
Water	1 liter

The current density should be 0.5 amp./sq. dm. and the bath should be agitated. Silver anodes are used and the temperature should not fall below 25°C. After deposition of 0.0005 in. of silver the more usual bath may be used, for example:

Silver cyanide	45 g.
Potassium cyanide	60 g.
Potassium carbonate	50 g.
Water	1 liter

This bath is used at a current density of 0.3 amp./sq. dm. and a temperature of 25°C. for the deposition of copper on metallized coatings, the ordinary acid sulphate bath may be used, but there is less tendency to rupture the deposit in the initial stages if the alkaline copper sulphate solution is used.

Copper sulphate	50 g.
Sodium hydroxide	45 g.
Rochelle salt	150 g.
Water	1 liter

The current density should be about 0.5 amp./sq. dm., and the temperature is best maintained at 25°C.

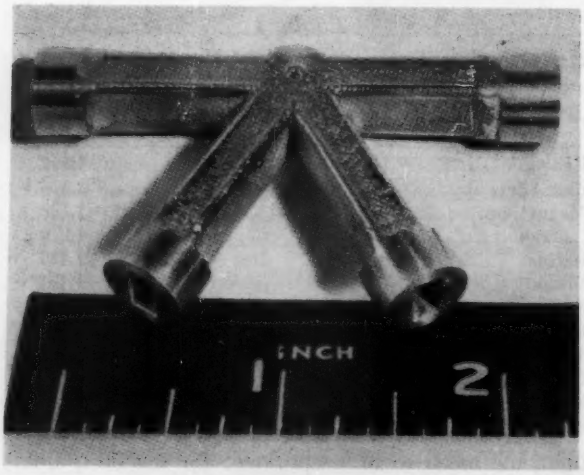

Figure 2. Electroformed waveguide.

A bath which has been found most suitable for the initial deposition on chemically reduced films is the triethanolamine bath described by Schweitzer.[17] A typical example is:

Copper sulphate	25 g.
Rochelle salt	10 g.
Triethanolamine	25 ml.
Water	1 liter

The current density recommended is 0.3 amp./sq. dm., and after plating for 15 minutes the article should be transferred to the normal acid copper bath.

A nickel bath recommended by Crocker[18] is composed of:

Nickel sulphate	100 g.
Boric acid	10 g.
Water	1 liter

It is also suitable for an initial deposit of nickel on the metallized films. A further solution used for nickel employs ammonium chloride in place of boric acid.

In electroplating on metallized coatings, care must be taken to insure that the voltage is applied before immersion of the object in the bath, thus minimizing attack on the films by the plating solution. Another precaution worthy of note is that heated solutions should be avoided, since the large differences in expansion between metals and plastic or glass bases will cause stripping or lack of adhesion. It may also be mentioned that solutions which are strongly acidic or strongly alkaline should not be used, or attack on the base materials may occur. When adequate measures are taken, however, the baths detailed above will be found to give excellent deposits.

Comparison and Uses of the Methods

One advantage of metallizing by reduction from aqueous solutions is that no elaborate equipment is required for the process, and since in the majority of applications silver is used, the limitation of the possible metals reducible from solutions is not serious. The method is particularly suitable for providing conducting metal films on insulating materials prior to electrodeposition, and a typical use of this is in electroforming practice. By this means, complex shapes in plastics or waxes are reproduced in metal by building up thick electrodeposits on the initial metallized films until they possess the necessary mechanical strength. This enables many intricate shapes to be made in a much simpler and less expensive manner than could otherwise be possible by machining. An example of an electroformed waveguide component is shown in Figure 2 to illustrate this technique.

The firing method is limited in use to vitreous materials capable of withstanding high temperatures, but the value of the process is in the great adhesion of the metal coat when correct conditions are applied. This process has long been used in pottery decoration, but one of the more recent developments is the use of the metal film as a resistance material. Resistors produced by engraving thin metal films of a gold-platinum mixture fired on glass or glazed ceramic surfaces have been found to be extremely stable and reliable, possessing all the properties of a high grade component. Various types of resistor have been made,[19] and these in-

(*Concluded on page* 80)

EXTRACTS
From the World's Plating Literature

New Pickling Processes for Iron and Steel

E. Brauns; *Metalloberflaeche*, vol. 6, No. 10, pp. A145-A152.

It has been customary up to recent times to pickle steel sheet intended for special processing such as enamelling or galvanizing, in hydrochloric acid but most recent practice is to conduct the pickling in a sulfuric acid bath. It is necessary however to counteract the disadvantageous effects of the sulfuric acid pickle, which comprise a greater amount of a black deposit and of iron salts being left on the steel surfaces with the sulfuric acid pickle than is the case with the residues left on the surface after pickling with hydrochloric acid. To avoid this deposit, after rinsing, a neutralizing dip is given in a dilute caustic soda solution containing sodium cyanide. The function of the sodium cyanide is to separate out the iron sulfate obstinately retained in the pores of the metal surface as iron hydroxide, as it is converted by an alkaline cyanide solution into complex iron compounds according to the following equations:

(1) $2\ NaCN + FeSO_4 = Fe(CN)_2 + Na_2SO_4$

(2) $Fe(CN)_2 + 4\ NaCN = Na_4\ Fe(CN)_6$

The sodium ferrocyanide is an iron complex soluble in alkaline solution and, corresponding to the above reactions, the steel surface is completely neutralized in the alkaline sodium cyanide solution and simultaneously is freed to a very considerable extent from iron salts. The bath in which this cleaning stage is conducted contains 2-6 g./L. of sodium cyanide and is carefully maintained at a pH value of 11 in order to avoid the generation of hydrocyanic acid gas. The effectiveness of the bath is increased by the addition of wetting agents and by increasing the temperature up to 75°C. The consumption of sodium cyanide works out to 500 grams per ton of sheet treated. It must be considered that this solution attacks a number of the corrosion-resistant metals currently used in pickling tank construction practice, such as lead, copper or bronze. Satisfactory results are obtained with parts such as tubes and sheet, which are pickled with sulfuric acid coupled with this surface cleaning treatment and then galvanized. It can be assumed that the treatment would also be suitable for the surface preparation of steel intended for other surface treatments such as enamelling and lacquering.

Pickling with phosphoric acid has considerable technical advantages, particularly when the treated metal surface is intended to be subsequently coated with an organic lacquer finish, as a thin adherent iron phosphate coating is left on the metal surface with correct bath operation. A careful washing and rinsing, such as is necessary after pickling with hydrochloric or sulfuric acids, is not necessary after a phosphoric acid pickle. The high price of the phosphoric acid is, however, a commercial disadvantage which stands in the way of a general application of the phosphoric acid pickling process. Ion exchange treatment by means of synthetic resin, of the exhausted bath liquors containing phosphate salts and the resultant generation of the phosphoric acid for a fresh pickling cycle would appear to solve this problem.

The regenerated phosphoric acid is passed back to the pickling bath. The loss of phosphoric acid by the regeneration process is negligible. When the effectiveness of the ion exchange medium has become exhausted, it is regenerated by treatment with sulfuric acid. Operating results have indicated that pickling with phosphoric acid, adopting the above measures, need be no more costly than with a sulfuric acid pickle.

The development of pickling bath inhibitors may be regarded as having reached practical finality so that there are available today on the market a whole series of pickling inhibitors which exhibit more than 95% inhibiting efficiency. Many procedures have been developed to test the effectiveness of a pickling inhibitor; the one developed by Wickert provides information regarding the effect of the inhibitor on the solution rate of the iron and also on the solution rate of the scale. This test also provides conclusions as to whether the addition of the inhibitor being tested causes a prolongation of the complete pickling process and how great this prolongation is. Research has not yet provided a clear overall picture of the mechanism of the inhibition. One school of thought considers that the most feasible explanation is that the attack of the acid is inhibited by adsorption of the inhibitor on the metal surface while another line of thought is that the inhibitive effect is caused by a strong increase in the hydrogen overvoltage. Bath additions of wetting agents and surface active compounds tend to reduce the pickling time and also to save acid by better draining of the ware and less drag-out.

Influence of Pickling on Subsequent Surface Treatment Such as Plating etc. — Surface Properties of Pickled Metals

R. Petri; *Metalloberflaeche*, vol. 6, No. 10, pp. A152-A158.

More exacting demands on surface quality with modern metal finishing processes have led in turn to precise requirements requiring the surface qualities of the starting material for surface processing such as plating etc. It is known that this as regards the specific surface properties of the material, depends to a large extent on the surface preparation procedues and techniques employed. Pickling represents today, particularly when heat treatment or hot processing of the metal such as hot rolling has been conducted, one of the most effective surface cleaning and preparation processes. The present investigational study researches the property changes of the metallic surface which occur through the acid treatment, which could be of technical significance when a coating is subsequently applied on the metal as by plating, for example. The work comprised the establishment of the surface roughness characteristics after pickling, on hydrogen absorption and expulsion during and after pickling and the formation of surface films and their technical

significance and effect on the formation of a metallic coating film by plating.

For the measurement of the surface roughness of of the pickled surface, the Forster-Leitz test was chosen. By means of the surface profile curves which are obtained with this system of measurement, a comprehensive picture of the surface roughness is obtained over an area of several millimeters and there is obtained, by measurement of the roughness peaks and valleys, a quantitative determination of the micro-roughness. As test material there was used steel sheet of a killed German S.M. steel of 1 mm. thickness which had received a normalizing heat treatment after rolling. To ascertain precisely the influence of the pickling acid attack on the micro-roughness after pickling in hydrochloric and sulfuric acids, the ground and polished surface was subjected to pickling. It was found that the surface roughness was associated to a close extent with the iron-attacking action of the acid used and in such a manner, that increased metal loss during pickling, whether because of too long a pickling time, too strong an acid concentration or too high pickling temperatures had the result less of causing a change in the surface macro-roughness but rather of increasing the micro-roughness. Any noteworthy difference in the nature of the attack under the test conditions or because of the specific effect of one of the two acids used could not be established.

The effect of additions of pickling inhibitors to the bath was then investigated. It was found that as a direct result of the addition of the inhibitor in the direction on surface-quality improvement of the pickled ware, in connection with the iron-protective action there was obtained a reduced roughening of the surface. As compared with the comparatively strongly roughened surface of the steel sheet pickled in the bath without inhibitor, all the inhibitor treated baths gave more or less smooth surfaces, which were apparently only very lightly etched. It was found by further test, that the protective effect of an inhibitor, particularly with prolonged pickling times, is dependent to a large extent upon the content of the steel in secondary accompanying elements. The question of hydrogen absorption and consequent pickling embrittlement is always associated with pickling processes. With sulfuric acid pickling, investigation showed that most hydrogen was absorbed and subsequently evolved when pickling at normal temperature; with increasing bath temperature the amount of hydrogen absorbed is smaller. Greater embrittlement was found, however, in the sheet pickled at the higher temperatures. No noticeable hydrogen evolution after pickling was found when pickling inhibitors were used. With cathodic electrolytic pickling, considerable hydrogen absorption must be reckoned with. No hydrogen absorption was found when pickling in a fused salt bath. An investigation of electrolytic pickling, in hydrochloric and sulfuric acid solutions, showed that the metal losses with anodic pickling increased with increasing current density, greater with hydrochloric than with sulfuric acid. In addition, with current densities of 50 to 100 amps./sq. dm. a sudden rise in the iron losses occurred. This was associated with a strong smoothing effect on the metal surface, which led to a polishing effect so that the surface appeared glossy. This effect was more prominent when pickling with hydrochloric acid than with sulfuric acid in the electrolytic bath.

Little or no information is available regarding surface film formation caused by pickling in sulfuric and hydrochloric acid and their influence on the adhesion of plated coatings. The film is caused mainly by the Ni and Cu contents of the steel; these secondary elements mainly congregate at the boundary scale/metal. A quantitative estimation of the film adhering to the surface after pickling in an inhibited bath is difficult because of its extraordinary thinness. Tests showed that the acid solubility of an inhibitor film increased after rinsing in hot water.

METALLIZING GLASS, CERAMIC AND PLASTIC SURFACES

(*Concluded from page* 78)

clude a flat-plate form, with a zig-zag film pattern, enabling a high resistance to be obtained in a small space, spiralled films on glass rods, and metallized glass fibers of 0.001″ diameter. Other types attempted include flat-plate circuits and experimental potentiometers.

The wide range of metals as well as salts which can be deposited by evaporation makes the process invaluable in many ways, but it suffers from the disadvantage that only flat or slightly curved surfaces can be coated, and the equipment required is specialized. The best optical mirrors are produced by evaporating aluminum or silver on highly polished surfaces, such reflectors needing no subsequent treatment. In one method of constructing rectifier units, selenium is evaporated on steel discs, and the process is also used for depositing photo-cell elements.

It is evident that each of the processes has its own merits and none is suitable for all applications, but together they constitute a valuable asset with a wide field of usefulness.

Acknowledgments

The authors are indebted to the Chief Scientist, Ministry of Supply, for permission to publish this article.

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Shop Problems

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Tarnish Removal from Brass Nipples

Question: A major part of our production is steel pipe nipples, and our threading machines are filled with a sulphur base thread cutting oil which is carried over into the tote pans and other containers. When we occasionally thread 85% red brass we run into trouble. The thread cutting oil, if in contact with brass and copper, stains and darkens it almost black, which makes the product almost unsaleable.

It is almost impossible to clean out the machines and containers perfectly, although we try. We find it necessary to degrease the brass and copper nipples immediately upon their being threaded. But even after we take precautions, some pieces and quantities do become stained and blackened.

What we would like to do is to thread these brass and copper nipples using the sulphur base oil, run them through an oil spinner to remove the excess oil and then dip all the nipples to achieve a clean bright surface. The final surface should retain the approximate original appearance and color or the brass or copper.

Could you outline a procedure for handling this problem?

S. W.

Answer: To brighten up the brass nipples, they will first have to be cleaned in alkaline solution, after spinning off excess sulphur-base oil or degreasing. They can then be soaked in a solution of 4 oz/gal sodium cyanide or dipped in a solution containing 4 oz./gal. sodium dichromate and ½ pint sulfuric acid per gallon of water. The latter will produce a brighter finish. Rinsing and drying, of course, follow either dip.

Solder Removal

Question: We have certain electronic parts made of steel that we silver plate .0002-.0003 thickness. These have been rejected in assembly and come back to us with 60-40 solder on them, sometimes in lumps. We would like to strip these parts and replate them but don't know of a good solder stripper. It is important that we remove all of it and start from scratch.

W. G.

Answer: A compound for stripping solder from steel without the use of current is obtainable from Enthone, Inc., 442 Elm St., New Haven, Conn.

Solder can also be removed by immersion at room temperature in a mixture of 95% by volume glacial acetic acid plus 5% by volume of 30% hydrogen peroxide.

Reverse current in a warm solution of sodium hydroxide will dissolve lead and tin and rochelle salt may be added to increase the stripping rate.

Black Conducting Deposit

Question: We are interested in obtaining a black finish on brass that would have little or no electrical resistance. We have tried several products, and although we have obtained a fine black finish, the coating offers too high an electrical resistance for our requirements.

H. J. B.

Answer: An arsenic deposit will probably answer your electrical requirement but the deposit is gun-metal gray, not black. Black nickel will give you a jet black deposit but it does not have high conductivity, although it would not be considered an insulating film. Other black finishes are generally copper oxide, which is an insulating film.

Anodizing Aluminum with Steel Inserts

Question: I am using a sulphuric acid type anodizing set-up. What I would like to do would be to anodize a die-cast aluminum housing with two steel bushings which are forced into the casting prior to anodizing. These bushings cannot be put into place after anodizing because it will distort the casting and, if I anodize the casting with the bushing, the sulphuric acid will etch the steel bushing. We have tried different kinds of bushings but none will compare with the ones that we are using. These pieces have to stay in the anodizing tank for 20 minutes. I have tried different waxes, but none will withstand the anodizing. Is there any coating that can be applied to these steel bushings and still withstand the acid? Is there any protective film that would compare with anodizing that I could use?

J. S.

Answer: We would suggest capping the bushings prior to anodizing.

Neoprene caps which might be suitable can be obtained from Duggan Masking Devices, 2030 W. Fort St., Detroit 16, Mich., under the name of "Caplug."

Chromate type conversion coatings are sometimes specified as an alternate to anodizing, especially for use as a paint base. You can check on their suitability for your purposes. These coatings are produced by immersion and the compounds generally have no appreciable effect on steel.

Chromium Plating Alloy Steel

Question: We have received inquiries for the chrome plating of chrome-molybdenum steel. We have seen an American made article with the trade name of Chromoly 4131 (it is a semi-bright finish), but we do not know whether this trade name refers to the steel alloy, or the finish, and perhaps you will be able to give us this information. Could you furnish us with the process details, please?

W. F. D.

Answer: We can find no reference to

an alloy called Chromoly 4131, but the 4100 series steels are chromium-molybdenum steels.

Logozzo has suggested the following procedures for chromium plating these steels:

1. Alkaline clean, anodically at 6 volts, then etch anodically at 6 volts in 28 oz/gal chromic acid solution before plating. The etching time will range from 1 minute for thin deposits to 10-15 minutes for heavy deposits.
2. Clean anodically, as above, then etch anodically in a 25% sulfuric acid solution. Etching times will range from ½ minute for thin deposits to 3 minutes for heavy deposits.

Supplies for Bronzing Baby Shoes

Question: I have contacted several companies advertised in your Guidebook for mountings and supplies for metal binder baby shoes but I seem to get the wrong ones. I wonder if you could furnish me with some names of companies that handle this type of merchandise.

T. E. A.

Answer: Mountings and supplies for metallizing baby shoes may be obtained from:

Hollywood Bronze Supply
1624 East First Street
Los Angeles 27, Calif.

Stains on Bright Dipped Brass

Question: We are using a chromic-nitric bright dip for polished brass giftware and have trouble with the local water causing brown spots to appear near the seams. The addition of chlorine in the water seems to help. Can you suggest another chemical that would react to prevent spotting, but not so strong that it would etch. Soda causes a spotting of the surface. Would a demineralizer be our solution?

Under separate cover we are forwarding you a piece of brass that has spotted in the seams to give you an example of our problem, also the water analysis.

L. D. C.

Answer: Your water supply is very bad and the use of a water demineralizer would be advisable. This is not the cause of the staining, however.

The stains on the sample forwarded are due to bright-dip solution being trapped in the recesses and leaking out afterward. They can be eliminated by soft soldering in such a manner that the solder joint does not have any openings to trap solutions. After-treatments should include a cyanide dip to neutralize the remaining acid and a bake at about 225° F. to dry out the recesses.

Chromium Diffusion Process

Question: In the April issue of METAL FINISHING you ran an article entitled "Chromium Diffusion for Corrosion and Abrasion Resistance." Will you please advise as to which of the firms mentioned in this article can give us complete information on this process.

R. W. S.

Answer: Write to:
Diffusion Alloys Corp.
109 West 64th Street
New York, N. Y.

Chromium Plated Hardened Steel

May 18, 1953

Metal Finishing
381 Broadway
Westwood, N. J.

Gentlemen:

In reading through the "Shop Problems" may I refer to your answer on chromium plating hardened steel, signed "M. L." I would like to add my solution to his problem which I think is a better one all the way through. In our shop we would grit blast. Under these conditions, we have found that we save time and money by eliminating the defects in this type of steel.

Yours very truly,
E. V. Collins

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Recently Granted Patents
in the Metal Finishing Field

Patents

Lead-Antimony Alloy Electroplating Bath

U. S. Patent 2,634,235. *April* 7, 1953. *A. L. Hitchens and R. G. Owens, assignors to Olin Industries, Inc.*

A bath suitable for the electrodeposition of a lead alloy containing about 8 to 10% antimony having as its functioning ingredients in an aqueous medium antimony, lead, fluoborate anions, and tartrate anions, said ingredients being substantially in the relative proportions of about 200 parts by weight antimony cations, about 1,700 parts by weight lead cations, about 1,600 parts by weight fluoborate anions, and about 300 parts by weight tartrate anions.

Plating Non-Conductors

U. S. Patent 2,635,053. *April* 14, 1953. *M. Schwartz.*

An adhesive composition which is adapted to form a very thin layer of metal-powder holding adhesive on non-metallic mold surfaces which adhesive is resistant to attacks by electroplating baths consisting essentially of the following ingredients in the range of proportions indicated:

Gum mastic	approximately ½ oz.
Rosin (powdered)	approximately ¼ oz.
Friar's balsam	approximately 2 cc.
Balsam Peru	approximately 5 cc.
Chloroform	approximately 125cc.

Fused Salt Bath Cleaning

U. S. Patent 2,635,063. *April* 14, 1953. *R. Dunlevy, H. Frick and J. H. Shoemaker, assignors to Kolene Corp.*

In the cleaning of metal strips by running continuous lengths thereof through a hot molten alkali metal salt bath reactive with the surface of the metal and impurities therein whereby the strip of metal emerges from said bath in a highly heated state having evenly etched surfaces coated by a thin water soluble film of said molten salt, the method comprising quenching and rinsing said hot molten salt coated film on said metal strip by passing the same continuously into a cold water bath wherein substantial uneven ebullition and vaporization of vapors and alkaline chemicals take place upon contact with said bath to form a vaporous mist above said water bath from which alkaline vapors and condensed droplets therefrom tend to redeposit irregularly upon the strip to spot the same and impair the evenly etched surface formed in the molten alkali metal salt bath, and simultaneously and continuously withdrawing all of the said vaporous mist and mechanically entrained alkaline chemicals from over the entire surface of said bath to prevent redeposition of alkaline droplets upon said cleaned metal strip.

Fused Salt Bath Cleaning

U. S. Patent 2,635,064. *April* 14, 1953. *J. A. Faler, assignor to Kolene Corp.*

In a metal cleaning process, the steps of immersing a work piece in a molten alkali metal salt bath, thereafter suspending the hot work piece, dripping wet with molten salt, above a shallow pool of running water, and thereafter immersing the cooled work piece, from which much of the molten salt has dripped off, into a water rinse bath.

Bright Nickel Plating

U. S. Patent 2,635,076. *April* 14, 1953. *A. H. Du Rose, assignor to The Harshaw Chemical Co.*

A nickel plating solution essentially consisting of an aqueous, acid solution of nickel material supplying nickel ions and an addition agent dissolved in said solution and capable of imparting to electrodeposits produced therein improved smoothness and buffability, said solution essentially consisting of a composition of the class consisting of aqueous solutions of nickel sulfate, aqueous solutions of nickel sulfate and nickel chloride, aqueous solutions of nickel fluoborate, aqueous solutions of nickel fluoborate and nickel sulfate and aqueous solutions of nickel sulfamate and said addition agent being selected from the class consisting of coumarin and its substitution products wherein a substituent of the class consisting of alkyl radicals containing not more than four carbon atoms, acyl radicals containing not more than four carbon atoms, and chlorine, hydroxyl and carboxyl groups replaces a hydrogen atom of the coumarin, such addition agent being dissolved in said solution in concentration from 0.05 gram per liter to saturation.

Acid Pickle Addition

U. S. Patent 2,636,009. *April* 21, 1953. *J. T. Irwin.*

A process of improving the surface condition of a metal in an acid pickling bath which consists in treating the surface of the metal to be pickled with a bath consisting of a pickling acid which is predominantly sulfuric acid and one to eight parts of sodium thiosulfate per seven hundred parts of 7% H_2SO_4.

Buffing Machine

U. S. Patent 2,635,394. *April* 21, 1953. *F. E. Wing, Jr.*

In a polishing machine, the combination of an elevated horizontal endless conveyor having means thereon for suspending therefrom articles or parts to be polished, said conveyor having a stretch thereof extending in a straight path, a polishing wheel, and a mounting for said polishing wheel supporting the same with its axis lying in a plane parallel to the path of travel of article suspending means on said straight stretch of the conveyor at one side thereof, said mounting including a base, a pedestal on the base, a frame on the upper end of the pedestal having a universal joint connection therewith providing for tilting the same about an axis perpendicular to the path of travel of the article suspending means on the straight stretch of the conveyor, and also for tilting the same about an axis parallel to the path of travel of said

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article suspending means and laterally toward and from the path of travel of said article suspending means on the conveyor, two screw threaded adjustable pivotal link connections between said frame and said base for affecting angular adjustments of the frame and to maintain the same in different positions of adjustment, and a platform on which the polishing wheel is mounted, slidable on said frame toward and from the path of travel of said straight stretch of conveyor, and means for moving said platform to different positions along said frame and for maintaining the same in different positions of said last mentioned adjustment.

Vacuum Metallizing

U. S. Patent 2,635,579. *April* 21, 1953. *E. E. Chadsey, Jr., assignor to National Research Corp.*

Apparatus for coating a substrate with a metal by evaporating said metal on the substrate, said apparatus comprising a vacuum-tight chamber, an open-mouthed crucible for melting and evaporating said metal, means for positioning said substrate above said open mouth of said crucible, means for holding a supply of pellets of said metal, means for feeding individual pellets from said supply and along a path spaced from said crucible and extending downwardly below the mouth of said crucible, and means for deflecting said pellet at the bottom of its path to impart an upward and lateral motion to said pellet to cause said pellet to travel, under influence of kinetic energy acquired during its downward movement, in an arc terminating in said open mouth of said crucible, said deflecting means being shielded from the metal vapor stream emanating from said crucible mouth.

Buffing Wheel

U. S. Patent 2,636,324. *April* 28, 1953. *W. Ruthven, assignor to Ajax Buff Co.*

A buffing wheel comprising a cloth buff, clamping members at least one of which has axial air passages therethrough fixedly secured to said buff on opposite sides thereof, and cooling air pumping structure fixedly attached in coaxial relation to one of said clamping members, said structure including an integral attachment portion abutting said one clamping member, an integral substantially frusto-conical portion, and integral cooling air di-

recting vanes extending from the plane of said frusto-conical portion for pumping air axially through said passages and radially outwardly to cool said cloth buff.

Polishing Machine

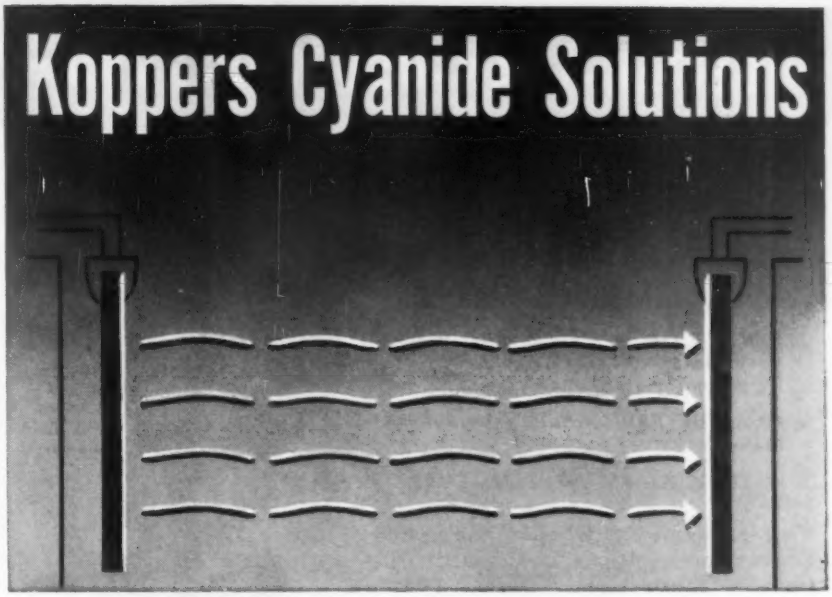
U. S. Patent 2,636,319. *April* 28, 1953. *W. B. Knight.*

A polishing machine for use in finishing the heads of screws and like workpieces, said machine comprising a hopper mounted for rotation about an inclined axis and having an axially upwardly presenting annular slot adapted to collect said screws and of a width adapted to receive the shanks of said screws but not permit passage of the heads thereof so that the screws are supported with their shanks hanging in said slot, a frame, conveyor means mounted on said frame for supporting said screws in position to be polished, motive means for driving said hopper and said conveyor means and operatively connected thereto, pick up and transfer means connecting said hopper and said conveyor means for removing said screws from said slot and transferring them to said conveyor means said pick up and transfer means including a slide defining a slot communicating at its upper end with said annular slot of said hopper, and polishing means mounted on said frame for polishing said screws during their movement on said conveyor means.

Polishing Machine

U. S. Patent 2,636,320. *April* 28, 1953. *W. B. Knight.*

A hopper for screws and other similarly headed workpieces, said hopper comprising a conical side wall, a bottom disposed in a plane perpendicular to the axis of said conical side wall and including an annular ring extending radially inwardly from said conical side wall at the smaller end thereof toward the axis of said conical side wall and a circular plate concentric with said annular ring and disposed within the central opening defined by said annular ring, said plate having its radially outer edge spaced radially inwardly of the radially inner edge of said ring and co-operating therewith to define an annular slot therebetween communicating with the interior of said hopper and adapted to collect said workpieces therein, means external of said hopper sup-



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Sodium Cyanide, 26-30%—a complexing agent manufactured from high purity hydrogen cyanide, reducing to a minimum the amount of contaminating organic chemicals and inorganic salts. Extremely low sulphur content.

Barium Cyanide, 30%—suggested as a cyanide plating bath additive, particularly in cadmium plating to remove the troublesome effect of carbonates and sulfates in the bath. Combines the qualities of high purity and low sulphur content.

Potassium Cyanide is available in 55-gallon drums or tank truck quantities. Sodium Cyanide is available in tank truck and tank car quantities. Barium Cyanide is offered in 55-gallon drums. The lower price structure and safe, easy-to-use liquid form of these cyanides, make them especially desirable to the electroplater. For further details, write to:

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Large sided wood barrel

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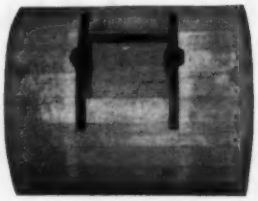

Horizontal wood barrel

Round wood barrel

SINCE 1880 DESIGNERS and BUILDERS of Tumbling Equipment

THE HENDERSON BROS. COMPANY
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porting said circular plate disposed as above described, a plurality of baffles mounted on and spaced about the inner side of said conical side wall, said baffles projecting inwardly from and extending generally axially along said side wall.

Bright Copper Bath

U. S. Patent 2,636,850. *April* 28, 1953. *G. W. Jernstedt and J. D. Patrick, assignors to Westinghouse Electric Corporation.*

An aqueous cyanide electroplating electrolyte composed of from 2 to 15 ounces per gallon of copper, alkali metal cyanide in an amount to complex the copper in solution and to provide from 0.5 to 5 ounces per gallon of free alkali metal cyanide, from 2 to 8 ounces per gallon of alkali metal hydroxide, from 1 to 20 ounces per gallon of alkali metal carbonate, from 0.004 to 0.57 ounce per gallon of zinc and from 0.1 to 10 ounces per gallon of thiocyanate, the zinc and thiocyanate jointly enabling smoother and brighter copper electrodeposits than either alone.

Method of Electroforming Gun Barrels and Liners

U. S. Patent 2,636,849. *April* 28, 1953. *A. Brenner, assignor to the United States of America.*

The method of manufacturing a gun barrel having a rifled bore out of metals that are highly resistant to erosion and corrosion but are too hard to machine or cast conveniently, which comprises making a metallic "negative" form whose external dimensions substantially correspond to required internal dimensions for the desired gun barrel's rifled bore, polishing said "negative" form to a smooth finish, plating upon the outer surface of said "negative" form a thin layer of a fusible metal which does not readily alloy with the metal of the "negative" form, thereafter electropolishing the fusible metal-coated "negative" form to a bright and smooth finish, thereafter electroplating the metal from which said gun barrel is to be made to a desired part of the desired total thickness upon the outer surface of said fusible metal-coated "negative" form at a temperature below the melting point of said fusible metal coating, thereafter machining smooth the outer surface of the metal which has been thus electroplated upon the fusible metal-coated "negative" form in order to eliminate the contour of the underlying lands and grooves from the subsequent plating, thereafter resuming electroplating the metal from which said gun barrel is to be made as aforesaid until the desired total gun barrel thickness plus a margin for final machining has been reached, thereafter heating the thus electroplated "negative" form to a temperature high enough to melt and eliminate said fusible metal coating from said "negative" form, thereafter extracting said "negative" form from the resultant gun barrel that has been electroformed therearound, and then machining the outside wall surface of the resultant gun barrel to the desired overall cross-sectional dimensions.

Vapor Metallizing

U. S. Patent 2,637,298. *May* 5, 1953. *Z. M. Shapiro, assignor to the United States of America.*

In combination, a vessel adapted to contain a decomposable vapor of a metal compound, electrodes mounted within said vessel, a filament adapted to be maintained at a temperature above the decomposing temperature of said vapor by a current supplied to said electrodes, and means for attaching the ends of said filament to said electrodes, said means comprising a detachable adaptor attached to the electrode and a plurality of spaced members fixed at one end to said adaptor, one of said members having an

end of said filament attached to the non-fixed end thereof and with the non-fixed ends of the remaining members suspended in space and terminating adjacent the point of attachment of said filament, whereby deposited metal may progressively bridge the spaces between the non-fixed ends of the members.

Aluminum Etch

U. S. Patent 2,637,634. *May* 5, 1953. *R. D. Howard and R. E. Samuelson, assignors to Beech Aircraft Corp.*

Aluminum etch comprising the following in approximately the proportions:

Nitric acid, 42° Be	3 gallons
Hydrofluoric acid (48-52% HF)	20 gallons
Boric acid	9.3 pounds

Water to make 100 gallons total.

Buffing Machine

U. S. Patent 2,637,147. *May* 5, 1953. *J. N. Clyne, assignor to Grinding and Polishing Machinery Corp.*

A buffing machine having a cabinet-like support, a rigid transverse beam secured across the top of said support, said beam being extended on each side thereof to provide rigid arm portions tapering to a reduced cross section at their respective ends spaced outwardly and laterally from said support, a pair of inner spindle bearings secured to the underside of said beam within said support, a pair of outer spindle bearings secured to the underside of said beam at the respective ends of its arm portions, whereby said bearings will be maintained in rigid alignment, a two-section spindle mounted in said bearings having a coupling between said sections intermediate said inner bearings, the ends of said spindle projecting beyond said outer bearings to receive buffing or polishing wheels for rotation thereby, a driving pulley secured to one section of said spindle intermediate said bearings, and driving mechanism therefor mounted within said cabinet-like support.

Stripping Silver Mirror Films

U. S. Patent 2,637,669. *May* 5, 1953. *K. E. Brown, F. E. Clark and C. E. Jackson, assignors to Turco Products, Incorporated.*

A process for stripping silver mirrors, which comprises immersing said mirrors in a water solution of a halide chosen from the group consisting of an alkali metal and ammonium halide at a temperature ranging from atmospheric to 200°F., and stripping the silver from the glass.

Stripping Silver Mirror Films

U. S. Patent 2,637,670. *May* 5, 1953. *K. E. Brown, F. E. Clark and C. E. Jackson, assignors to Turco Products, Incorporated.*

A process for removing silver mirror films from glass, which comprises immersing the mirror in a mirror stripping agent comprising a water solution containing sulfide ions at a temperature in the range of atmospheric to about 175°F., removing the mirror film from the glass, and washing the glass.

Nickel Bath

U. S. Patent 2,637,687. *May* 5, 1953. *L. B. Portzer and W. C. Leitenberger.*

A method of electrodepositing nickel from a nickel electrolyte comprising an aqueous acid solution of a nickel salt, comprising the step of electrolyzing said nickel electrolyte in the presence of a reduced triphenylmethane dye obtained by the reaction of the corresponding triphenylmethane dye with a reducing agent comprising zinc powder and hydrochloric acid, and a holding agent selected from the group consisting of sodium bisulfite and sodium hydrosulfite.

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Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

"King Size" DC Power Source

Bart-Messing Corp., Dept. MF, Belleville, N. J.

Completion of a single cubicle selenium rectifier with an output capacity of

30,000 amperes of dc power at 12 volts, and occupying only 96 square feet of floor space, has been announced by the company. The rectifier, largest single cubicle unit ever built, is being installed in South Portland, Me. where it will be used to furnish low voltage dc power for electroplating of nickel-lined steel pipe for Atomic Energy Commission projects.

To eliminate costly maintenance, the huge rectifier is completely sealed and gasketed for protection against the corrosive atmosphere commonly found in plating plants. An air-to-water heat exchanger will cool the unit with air recirculated within the cabinet. An interior temperature of 95°F. will be maintained regardless of outside conditions. The rectifier is a specially designed Reactronic unit, a company development which completely eliminates moving parts. Because of its corrosion resistance, the rectifier can be installed near the plating tanks, to eliminate long and costly bus bar installations.

Dry Acid Pickle

The Mitchell-Bradford Chemical Co., Dept. MF, 2446 Main St., Stratford, Conn.

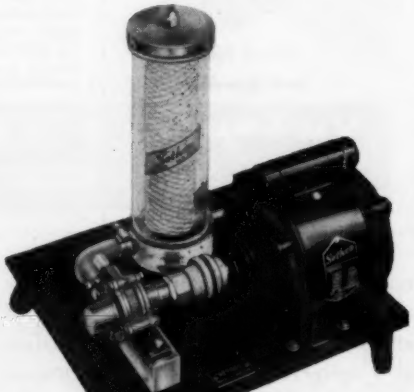
The company announces a new product "Quick-Pik," a dry, acidic salt mixture which, when mixed in the proportions of two pounds per gallon of water will quickly remove scale and rust. The solution can be used at temperatures of 70° to 150°F.

Because the compound is furnished as a dry salt mixture, it can be safely handled and eliminates the hazards of handling liquid acids and the inconvenience of returnable glass carboys.

Incorporated in the formulation are inhibitor and a foaming agent which minimizes the attack of the acid on the base metal and produces a foam which covers the surface of the solution eliminating acid spray and reducing fumes to a minimum.

Self-Priming Filter Pumps

Sethco, Dept. MF, 70-78 Willoughby St., Brooklyn 1, N. Y.



Model LSIN-10

The manufacturer reports a number of additions to its line of filter pumps for filtering corrosive solutions, namely, Models LSIN-5 and LSIN-10.

They filter practically any acid or alkaline solution from pH 0 to pH 14 and may be used for filtering non-aqueous solutions. They will remove particles down to 1 micron in size and a strainer stops metallic objects. The pump is self-priming and has a suction lift of approximately 15 feet. It is fabricated of stainless 316 and has a Neoprene impeller. It will deliver 6 gallons/minute on open pumping and will develop 40 p.s.i. before shut off.

The filter assembly is fabricated of high temperature Lucite and is also available in Haveg, stainless 316, rubber lined or epoxy resin construction.

The motor is ¼ HP, 110 volt, 60 cycle, single phase, capacitor start, totally enclosed, ball bearing. Motors wired for 50 cycles and for 220 volts are also available. Filter, pump and motor are mounted on bakelite panel. Pure gum inlet and outlet reinforced hose are supplied. Model LSIN-5 panel is equipped with rubber feet. Model LSIN-10 panel is equipped with rubber ball bearing casters.

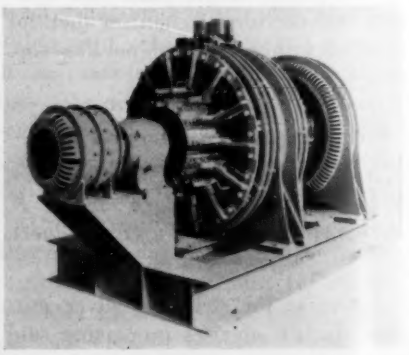
Model	Rated Capacity	Overall Size	Wt.
LSIN- 5	50 gal/hr	14x16x12" high	50 lbs.
LSIN-10	100 gal/hr	14x16x16" high	60 lbs.

Motor Generators

Chandeysson Electric Co., Dept. MF, 4074 Bingham Ave., St. Louis 16, Mo.

This company, designers and manufacturers of motor-generators for over fifty years, has made a redesign of its line of low voltage motor-generator equipment. The new line features improved commutation, all-welded steel construction, increased accessibility and more open ventilation, which results in greater overload capacity and higher overall efficiency.

Generator and exciter brushes, coils and commutator are now fully accessible for inspection, cleaning or re-



Bright Silver

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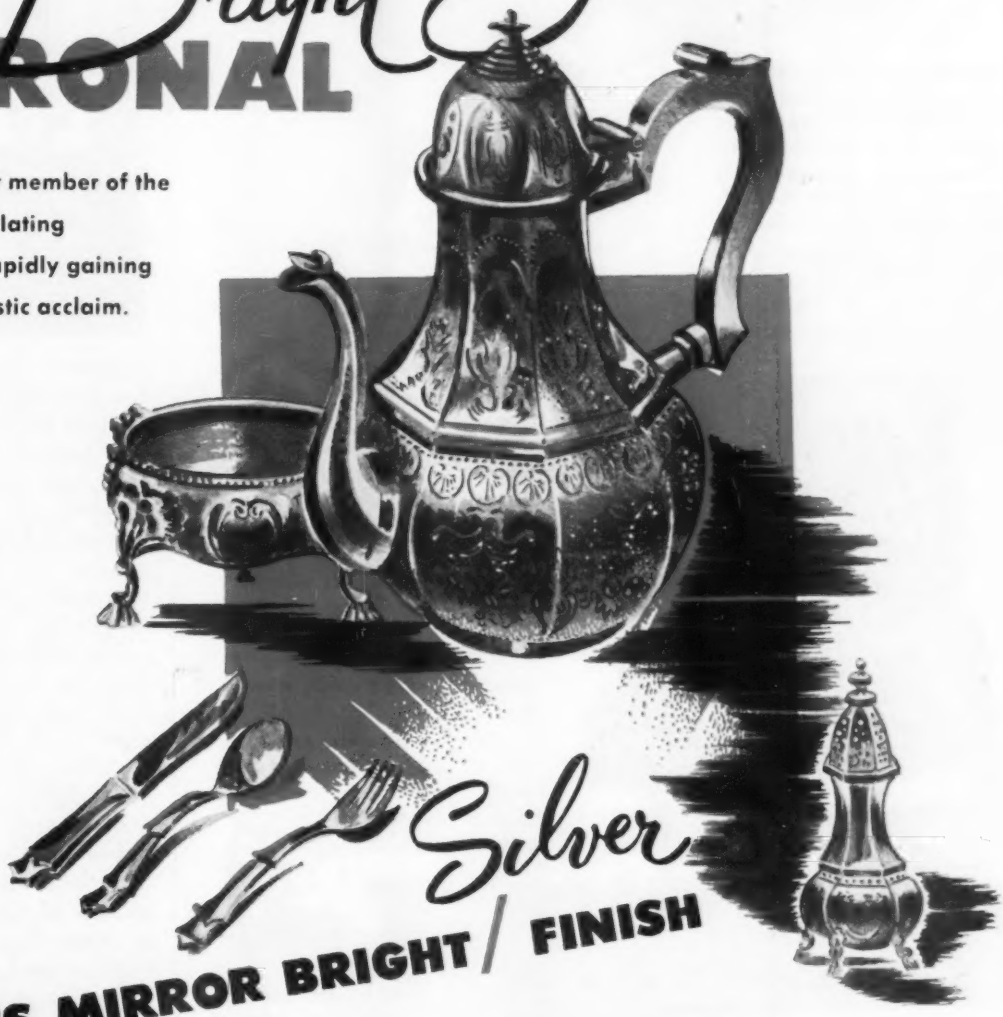
Process Team rapidly gaining
wide and enthusiastic acclaim.



Silver

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- Crystal clear solutions
- Sodium or potassium formulation
- Exceptional throwing power
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- Ideal surface for butler finishing

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BRIGHT SILVER	CUPRALL
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NICKEL-GLO	WATERSHED
MIRRO-GLO	SPRAY STOP

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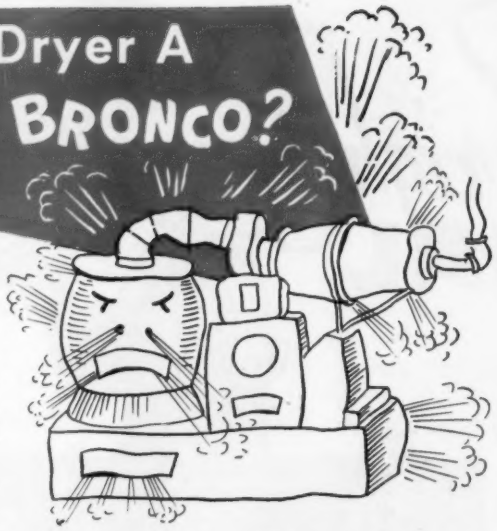
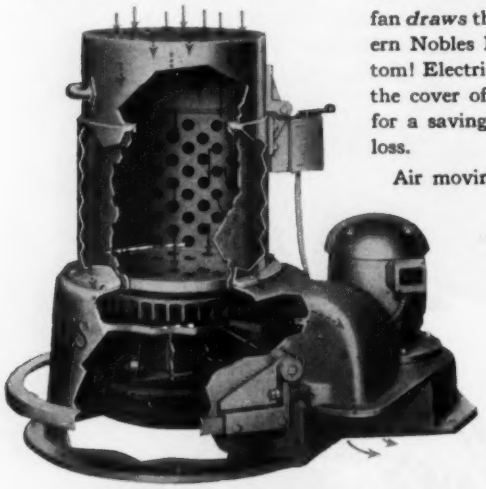
Is Your Dryer A BUCKING BRONCO?



In order for a centrifugal dryer to stay put it should be heavy. That's why the modern Nobles Dryer is about twice the weight of most dryers. Extra weight is one of the reasons for its stability, its freedom from vibration, its smooth operation, and long trouble-free life.

It's all new in design and principle. A powerful suction fan *draws* the air completely through this modern Nobles Dryer and exhausts it at the bottom! Electric or steam heaters are mounted in the cover of this machine of advanced design for a saving of space and elimination of heat loss.



Air moving equipment isn't an extra. The powerful suction fan is an integral design feature of each machine. A brake pedal extending around the entire work area controls an internal, expanding hydraulic brake for quick, smooth stops.

Why not take the first step now toward modern quick drying and lowest costs?

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moval, without the necessity of removing any other components. Higher overall efficiency is said to be realized with the new design which allows unrestricted air circulation around and through the generator. The exciter brushes are mounted on the inboard side to prevent accidental damage and also to insure smoother operation, thereby increasing brush life. Oversize split sleeve bearings adjacent to the commutators assure smooth operation and permit overloading without heating. Brush life is considerably increased with the new design which features sparkless commutation even at the guaranteed overload capacity of the generators.

Thte prime move is a direct-connected low speed, heavy-duty, synchronous motor with either 80 per cent leading or unity power factor.

Each motor is specifically designed to amply do the job required by the generator. High pull-out torque permits smooth and efficient operation even when the generator is overloaded. Extra windings on the rotor poles produce high-starting torque, permitting the use of across-the-line starting devices.

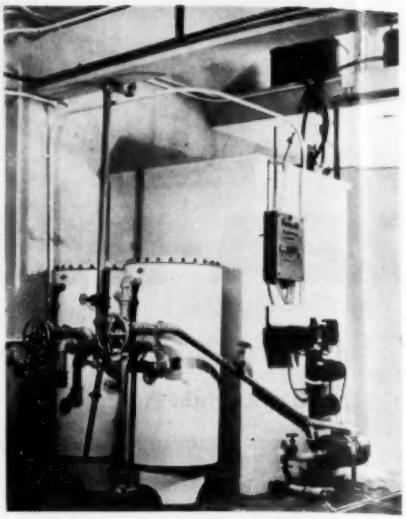
Generators are available in sizes from 300 to 20,000 amperes at specified voltages.

More information is available by writing to the above address.

Package Water Conditioner

The Permutit Co., Dept. MF, 330 West 42nd St., New York 36, N. Y.

Engineered to a high degree of efficiency and simplicity is the completely



integrated Permutit Package Water Conditioning Plant.

These units, without any alterations, may be used: (1) to remove turbidity, color and organic matter from water supplies; (2) to chlorinate; (3) to remove bad tastes and odors; (4) to remove iron and manganese; (5) to neutralize; (6) to soften and (7) to de-alkalize.

The plant, as a complete package, forms an extremely versatile and self-contained unit which is available in eight standard sizes ranging from 500 to 3,300 gallons per minute and flows of 12,000 to 79,200 gallons per 24 hours. Larger capacities can be furnished on request.

Each complete water conditioner consists of a precipitator with a built-in clearwell, a proportioning chemical feeder control, a coagulant feeder tank, a lime or soda ash and hypochlorite feeder tank, an inlet float control valve, Neutralite filter unit, Carbo-Dur purifier unit and a service pump.

Coating for Plating Racks

Hanson - Van Winkle - Munning Co. Dept. MF, Matawan, N. J.

The above company announces a new coating for insulating and protecting racks, fixtures and anode hooks. Kote-Rax Grade L, a plastisol coating, is specially formulated to reduce maintenance cost.

Because it is unusually tough and ductile, the coating will withstand rough treatment and abuse, and will wear longer both in and out of the plating bath. A smoother, more stable coating, it assures minimum drag-out loss; it retains its original color permanently. The original color is a light orange, which can be easily checked

for aging defects. The new coating is resistant to all of the commonly-used cleaning, pickling and plating solutions.

An electroplater can easily apply the coating to his racks and fixtures. Because the coating is solvent-free, no ventilating system is needed to carry away fumes. Only equipment required is a tank and a curing oven, both of which may be home-made. If the racks and fixtures are not too big they may be dipped in the Kote-Rax drums.

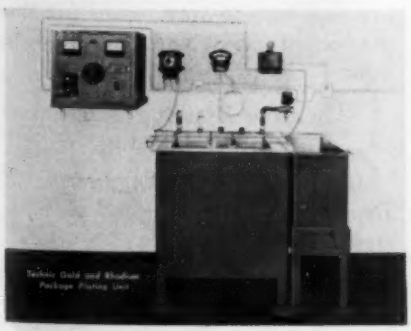
Before coating, a primer is applied to the racks. It is either brushed, dipped or sprayed on. The racks and fixtures are then heated to 350°F. for 10 min. While still hot they are dipped into the Kote-Rax Grade L until thoroughly cooled. Cooling usually takes from 2 to 5 min., depending on the size of the racks. After cooling, the racks are lifted out of the coating material and placed in an oven. Here they are baked for 10 min. at 350°F. If heavier insulation is wanted, a second coat may be applied. The pre-heating, dipping, draining and baking processes would be repeated. On the second run, however, the racks and fixtures would be given a 15-min. instead of a 10-min. bake.

Package Plating Unit

Technic, Inc., Dept. MF, 39 Snow St., Providence 1, R. I.

The above firm announces the development of a complete fully controlled package unit for the precision plating of gold and rhodium.

This unit, suitable for other specification or decorative plating, has a capacity of 40 gallons and offers for the first time fully automatic timing, heat control, individual power source and indicating metal replenishment control. The company also offers standardized soluble gold and rhodium of the highest purity for use with this unit and is prepared to detail the procedure for plating any thickness of gold, gold alloy or rhodium including full analytical procedure. This unit is moderately priced and full engineering service is available without charge.



Copper Bath Purifier

Sel-Rex Precious Metals, Inc., Dept. MF, 229 Main St., Belleville 9, N. J.

A new purifier, which eliminates the need for periodic dumping of copper plating baths by removing harmful solution breakdown impurities and converting them to useful cyanides, has been announced by this company. Sel-Rex Copper Purifier is a concentrated solution of pure salt prepared especially for use in cyanide copper plating solutions. It is a unique product since it adds no impurities to the bath and fills an important need in the copper plating field.

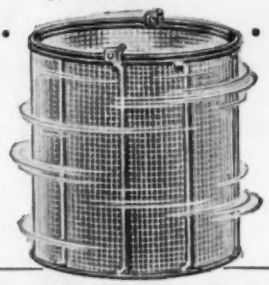
The copper purifier precipitates carbonates, chromates and sulphates as a heavy, dense insoluble precipitate while converting them to useful cyanides. The precipitate can be filtered out, or the solution can be decanted off the precipitate.

Addition of the purifier sharply reduces cyanide consumption and increases the cathode efficiency of the solution. Addition of one gallon of purifier will remove at least 38 ounces of sodium carbonate or 50 ounces of potassium carbonate. It will increase the sodium cyanide content of the bath by at least 35 ounces or the potassium cyanide content by at least 47 ounces. The product is shipped in 55-gallon drums, and is moderately priced.

PAYS FOR ITSELF... IN TIME SAVED

Kreider Dryer with auxiliary steam heating unit (illustrated). Auxiliary natural gas heating unit available; also standard model without auxiliary heating.

Basket (below). Heavy gauge woven steel mesh over steel frame. Capacity, 1140 cu. ins.



Spin-Dries* up to 50 pounds in less than 2 minutes

Saves drying time. Kreider Dryer operates on ¾ h.p. at 625 r.p.m. . . . cuts drying time to as little as 35 secs.—no more than 2 mins.—for each 50 lbs.

Saves production time. Runs at top speed with maximum load, hour after hour, day after day. Ends drying "bottle necks". . . assures smooth, evenly dried surfaces, longer lasting lustre—fewer "rejects."

Saves maintenance time. Simple, sturdy construction reduces "time-outs" for repairs and servicing to a minimum. Assures long life.

See for yourself! Write Department MF83 today for illustrated 4-page folder . . . also addresses of installations near you.

New Holland Machine Co., New Holland, Pa.

***Only 2 simple steps required . . .**

(1) Operator places wire mesh basketful of small parts in Dryer . . . turns motor "ON."

(2) Operator turns motor "OFF" . . . presses foot brake . . . removes basket.

NEW HOLLAND *KREIDER* DRYER

Close Tolerance Plating

American Electro Products, Inc., Dept. MF, 1358 Thomaston Ave., Waterbury, Conn.

The development of new methods for volume electroplating of intricate precision components with precious and common metals while holding to closest tolerances has been announced by the company.

The new techniques, known as the "Cantavone" controlled processes, are designed to plate components with the required number and type of electrodeposits in volume hitherto considered impractical and at less cost than conventional methods.

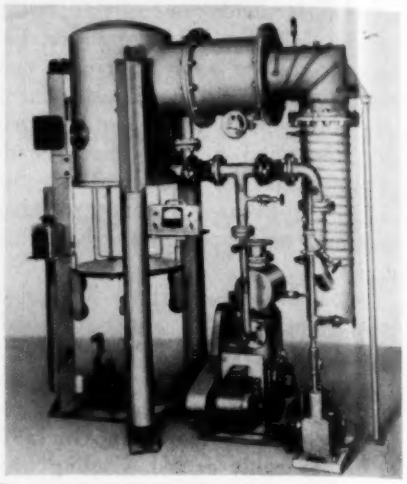
The new processes resulted from ten years of research and experimentation while plating components for Government and industrial applications in fields such as aviation, electronics, radar and communications for greater conductivity and to prevent corrosion from moisture, salt air, industrial fumes, contact with lubricants, extreme heat or cold and other causes.

The new techniques have proved practical in volume plating intricate components with as many as five electrodeposits controlled to plus or minus tolerances of 0.00001" to 0.000001".

A descriptive folder can be obtained by writing to the above company.

Vacuum Coater

National Research Corp., Dept. MF, 70 Memorial Drive, Cambridge, Mass.



The above company announces the Model 3111 Coater for development work and limited commercial production in vacuum metallizing. Although the vacuum evaporation of metals to provide metallic finishes on plastics, metals, fabrics, and glass has been established as a commercial process over the past ten years, process equipment has generally been limited either to laboratory apparatus or to large production units. Vacuum coating equipment has not previously been available for the transitional stage between experimental work in the laboratory and full-scale commercial production. The new coater bridges this gap and is designed for pilot and limited production.

It is priced at approximately one-third the cost of large production-scale equipment. Its high-speed pumping system features the NRC Rotary Gas Ballast pump which can pump water vapor without loss of pumping speed or capacity and without contamination of oil. All necessary instrumentation is an integral part of the machine. The vertical coating chamber is 24 inches in diameter and 30 inches high. One man can easily operate the coater and the vertical arrangement of the chamber and loading tray makes for short production cycles and ease of operation.

Abrasive Blasting Machine for Deburring

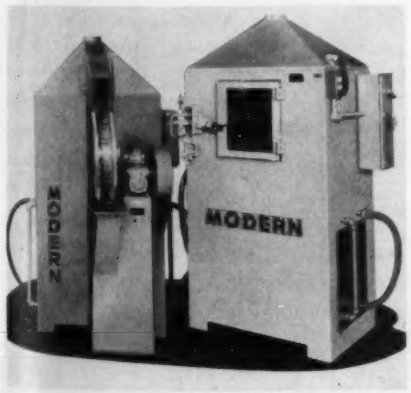
Modern Industrial Engineering Co., Dept. MF, 14230 Birwood Ave., Detroit 4, Mich.

Fast production deburring of "soft" metal parts, using either a continuous

rotating process for small parts or a stationary clamping arrangement for larger units, is possible with two standard Maizo Blast machines developed by the manufacturer. Both standard machine types are designed to remove light burrs from metals in the range of aluminum to mild steel. In both models, maize, or a similar "soft" material, is blasted against the parts under factory airline pressure. These machines are specially suitable to deburring parts that would be damaged by tumbling.

A ferris-wheel type fixture rotates continuously between two reciprocating blasting guns in Model MA-24 at the rate of approximately one revolution every five minutes. The revolving wheel carries 16 to 24 pieces in holding wires bent to suit the part and yields a production rate of 192 to 288 pieces per hour at 100 per cent efficiency. Higher production rates can be obtained, depending on the size of the part. A friction-driven slip clutch permits the operator to retard rotation if necessary. Speed of rotation can be varied as required by hardness of the parts being blasted by changing the drive pulley. Automatic transmission and aircraft parts are typical of those ideally suited to the continuously operating unit.

A ½ hp. motor belt-connected to a 3,000 to 1 speed reducer drives the ferris-wheel. The reciprocating and oscillating blasting arms holding the guns are driven through a crank from a second speed reduction drive that has its own ½ hp. motor. Housing is box-edge welded sheet steel. An access door is provided with a window for observation of parts during blasting operation. Normal plant air is all that is required for the machine, which operates at 60 to 80 pounds per square inch. The blasting material is reused constantly in the closed system. It falls into a funnel after blasting, is picked up by the airstream and recirculated. There is a slight loss of blasting material, of course, in the form of dust resulting from the blasting operation. This requires connecting the unit to a ventilating system.



Larger parts not suitable to the continuous machine can be handled in Model MA-1, a stationary unit in which parts rotate on a fixed axis in a fixture. Typical parts handled in Model MA-1 are impeller housings, rotors, etc. Since the angle at which the blasting guns are set depends on the nature of the part in process, the guns are adjustable and machines can be supplied with 2, 4 or 6 guns. A single ½ hp. motor and speed reducer supply power for the unit.

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- Stainless Steel Composition
- White Finish
- Tripoli
- Chrome Coloring Composition
- Greaseless Composition
- Emery Cake
- Brass Coloring
- Emery Paste
- Burring Compound
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- Spray Pastes Stainless Steel Tripoli

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The BUCKINGHAM PRODUCTS Co.

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New Compound Replaces Hydrofluoric Acid

Enthone, Inc., Dept. MF, 442 Elm St., New Haven, Conn.

The manufacturer has announced a new powdered product called "Actane 33" which, in many cases, will replace hydrofluoric acid. Because of the powdered nature of the product, there is much less hazard in handling it than with liquid hydrofluoric acid which can produce serious burns. The product 33 has many uses. It can be used in combination with sulphuric acid to remove silica, sand and scale from steel. It can be used with nitric acid and ferric sulfate for pickling of stainless steel. It is used with sulphuric acid for etching of aluminum and with

nitric acid to produce mixtures that remove silicon and copper from aluminum to produce white clean surfaces. Actaine 33 is recommended for use in acid pickles in plating cycles to remove siliceous films. Another use for Actane 33 is in pickling of titanium to replace hydrofluoric acid. The product contains soluble fluorides and penetrating and dispersing agents.

Wet Blasting Machine

American Wheelabrator & Equip. Corp., Dept. MF, 1150 S. Byrkit St., Mishawaka, Ind.

The addition of a new model to its line of wet blasting machines is announced by the manufacturer. Known as the Model 30 Liquamatte, it is intended for precision cleaning and finishing applications involving small pieces that can be lifted and handled manually.

This machine is 2′ 6″ in length by 2′ 6″ in width by 6′ 11″ in height and has a blasting compartment 30″ square and 2′ 7″ high. It has one vertical sliding door 1′ 10½″ wide and 1′ 7″ high. A 15″ diameter rotating work table is available for holding the work in the blasting compartment, and small portable auxiliary tanks are available to receive the parts from the blast chamber for rinsing.

Among the special features of this machine are push button controls. All of them are located on one central control panel convenient to the work station. To start the machine, the operator merely turns on the light and pushes two other starting buttons. There are no valves to open or close in either starting or stopping.

Another feature is the vertical pump for slurry agitation and recirculation. It is adaptable to rugged service, and because of its position, it eliminates all suction piping, valves, fittings, and labor for removing them for inspection of the pump. It is always primed by flooded-type suction. Loss of slurry through leakage is eliminated, because there are no packing glands. It is virtually impossible for the abrasive to plug the pump impeller when the machine is shut down. Another important feature is that the hopper need not be drained before the pump is removed.

The machine has a conveniently low work-ceiling, but the buttom of the machine is high enough off the floor to make good housekeeping possible. Rubber hose has been used instead of metal pipe wherever practical. Not only is this an advantage from a maintenance standpoint, but it eliminates noise from water hammer.

The armholes are equipped with gauntlets, which makes it possible for every workman to use his own gloves. The smaller parts to be cleaned can frequently be passed through the armholes without the necessity of stopping and opening the cabinet door. Gauntlet drainage has been carefuly designed so that there will be no slurry dripping down the front of the cabinet.

As a safety feature, the machine height is such that the average operator will be able to stand on the floor with no platform needed. A clear view of the work is easily available through the large vision window, and cool fluorescent lights do not cause abrasive to bake on the light well window, thereby cutting out illumination.

Low Volume Pneumatic Pump

Yeomans Bros. Co., Dept. MF, 1999 No. Ruby St., Melrose Park, Ill.

Compactness of design and the presence of only one moving part, a ball inlet valve, makes the pump simple to install, simple in operation. The pump is practically immune to high temperatures; will pump liquids near the boiling point; available with choice of: cast-iron, lead-lined, rubber-lined, or stoneware bodies; it is adaptable to the pumping of acids and other corrosive liquids. It can be operated from existing compressed air supply, from a separate compressor; or by means of a simple auxiliary apparatus, can be operated from a steam supply.

New Line Gas Burner

Eclipse Fuel Engineering Co., Dept. MF, Rockford, Ill.

A new product now in production is a gas-fired retention-type line burner for applications where heat must be distributed over a wide area by a continuous flame. The new burner is said to be excellent for oven heating and air heating installations, including make up air systems for spray booths.

The line burners are of the blast burner design, which insures good combustion with rich, neutral or lean mixture at all mixture pressures. The burners may be installed to fire in any direction: horizontally, vertically or downward. They are made of cast iron sections with drilled ports and steel retention lips for flame stability.

Abrasive Belt Splicer

Aget-Detroit Co., Dept. MF, Ann Arbor, Mich.

Improvements and changes in the Econaway abrasive belt splicer, designed to increase the speed of splicing abrasive belts, improve the quality of splice, save shop bench space and allow a still larger saving in the cost of abrasive belts, are announced.

The improvements include: an enclosure for the motor, the belt drive and the arbor which carries the grinding wheel; cutter and press bars are now mounted on top of the enclosure so that the operator can perform the various steps in splicing any grit paper or cloth backed abrasive belts without moving from one station to another; an electrical curing press to reduce the curing time from 24 hours to less than 60 seconds. Thus, there is not only a considerable reduction in the actual splicing time but abrasive belts may now be spliced even while a sanding

machine waits, since the splicing operation is completed so quickly and the newly spliced belt can be put into service instantly. An additional advantage is the reduction in space required for storing the belts during the 24 hour curing time as required with the old cold-press process. A vast increase of speed of clamping with the toggle type clamps, which are fastened to the lower segment of the press, is apparent when contrasted with the use of "C" clamps. Moreover, the toggle type clamp is always in position for instant action.

The new press is not only electrically heated but the temperature is controlled at the correct level by preadjusted thermostat.

Quick accessibility is provided for the occasional oiling and greasing of the motor and precision ball bearing arbor respectively and also for dressing the grinder wheel. The electric heater is controlled by an adjustable temperature thermostat. Both are enclosed in the upper press segment and are quickly removable for inspection or adjustment. A 6 foot "plug-in" cord is protected against wear at its point of entry into the press by a spring and bulkhead bushing.

Small Centrifugal Pump

Chempump Corp., Dept. MF, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

The above firm announces its new fractional horsepower model Chempump, a radically new approach to centrifugal pump design that practically eliminates pump maintenance.

The pump is totally closed from the atmosphere. It is a seal-less, leakproof pump . . . the answer to all maintenance and operating difficulties inherent in mechanical seals and stuffing

FIND OUT ABOUT **IRIDITE**® TODAY for finishing ZINC, CADMIUM, ALUMINUM, CUPROUS METALS

WANT CORROSION RESISTANCE? Iridite will give you better-than-specification protection against corrosion.

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POLISHING WHEEL CEMENT

KOLD-GRIP Polishing Wheel Cement, laboratory-controlled through every step of production, will arrive at your plant *ready for use!* Viscosity is constant, regardless of normal temperature variations and the cement can be applied directly from the container . . . *without mixing or heating.* Kold-Grip is clean, odorless and very easy to handle.

Coarse or fine-grain abrasives set up right for fast cutting efficiency. Substantial savings are effected through longer over-all wheel life, fewer set-ups and reduced wheel inventory.

Wheels dry rapidly, are unaffected by humidity changes, and may be stored in any convenient plant area.

Let our polishing engineer demonstrate Kold-Grip for you, or send for free sample, telling us the metal to be polished, grain sizes to be used, and drying facilities available. We can help you if we hear from you.

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LICENSED MANUFACTURER: Electric Resistance Furnace Co., Ltd., Weybridge, Surrey, England

HARTFORD *TRIPLE ACTION*

CUTTING *and* TUMBLING BARRELS

for better work in less time!

For uniform cutting down, wet or dry grinding, tumbling, pulverizing and mixing, the unique design of Hartford Triple Action Barrels saves time and money and produces better results. Hartford Barrels give a TRIPLE ACTION in tumbling the material, an "over and over, end to end, folding-in" motion combined, which quickly grinds off burrs, and finishes and smooths the general surface of any article in the load. These barrels are available in two sizes, large and small, and with both motor and belt drive. Hartford also makes steel burnishing balls scientifically correct in design and material for each specific job. Bulletin on request.

THE HARTFORD STEEL BALL CO.

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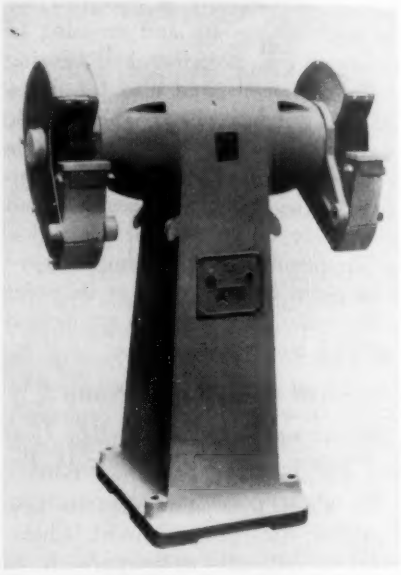
boxes of conventional centrifugal pumps. Available in a wide variety of materials it is especially well suited for handling corrosive, radioactive, and highly volatile fluids, and for processes where vacuum is used.

The basic principle of the pump permits the fluid being pumped to enter part of the motor. The stator and its windings are isolated from the fluid by a corrosion resistant, non-magnetic alloy cylinder inserted in the air gap. The rotor is hermetically sealed with the same alloy.

British Polishers and Grinders

Newage International, Inc., Dept. MF, 235 East 42nd St., N. Y. 17, N. Y.



The Stamford Works, London, England are introducing to the American market their line of polishers and grinders.

Although new to America, these products during their fifty years of service have gained an excellent world-wide reputation.

The machines are of extra sturdy, solid construction. The motors were designed for the machines. They are provided with extra large shafts to carry all kinds of loads yet offer smooth, vibrationless operation under any conditions. Combined with the heavy shafts are heavy duty bearings which permit these polishers to be used where a four-bearing machine would normally be regarded as essential.

Particular attention has been given to work space. There is adequate room for 2 operators working simultaneously even though they are handling work awkward in size and shape.

Electrically these machines are as

fine as the market offers. All slots are lined with high quality insulation and synthetic enamel wire. The starters for all 3 phase machines are of the inset type with no volt and 3 overload releases.

Soak Cleaner

Van Straaten Chem. Co., Dept. MF, 82 W. Washington St., Chicago, Ill.

A new, low-cost soak tank alkali cleaner that will remove oily soils, tars and soils of the type that can be cleaned in a degreasing solvent, is being introduced by the above manufacturer.

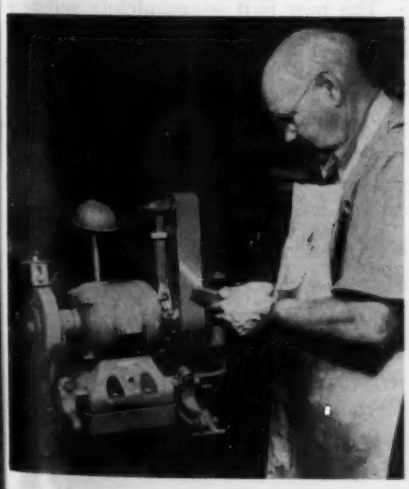
The new rapid industrial cleaner is part of the Vantrol 5499 series and is numbered 5499-F. It has similar properties of other recently announced products in the series which large industrial plants have tested and proclaimed to be a superior development, but is marketed at a markedly lower price ($.1200 per pound.)

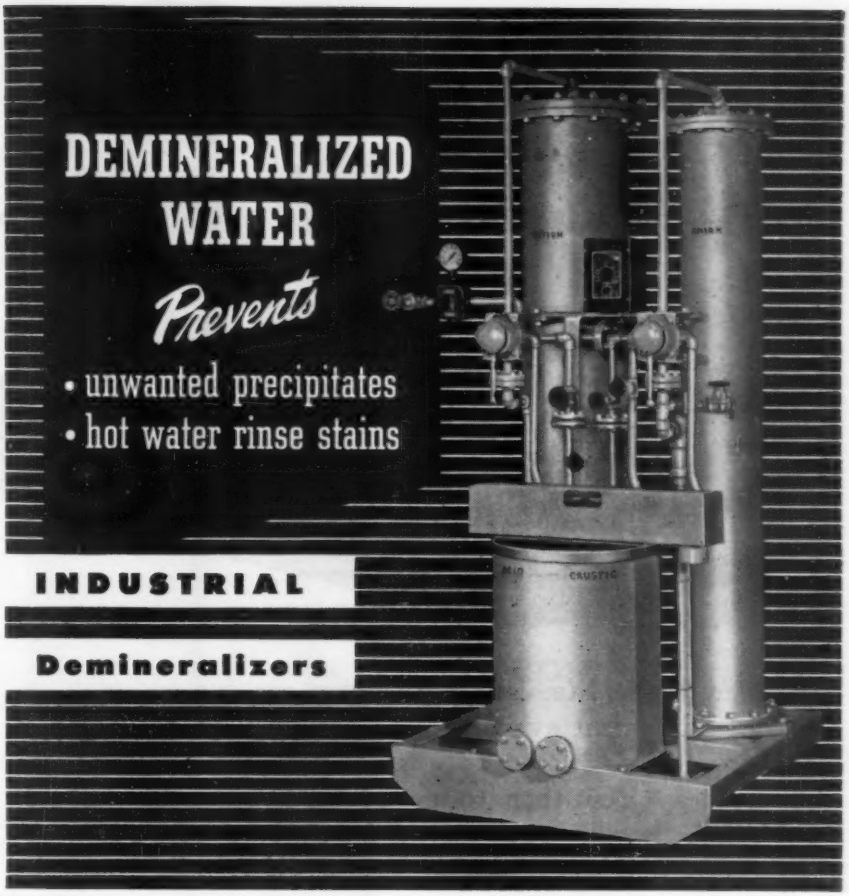
The material can be safely used on aluminum, copper and other non-ferrous metals. A water break free surface can be obtained with the cleaner. It can be used at 150 to 212 degrees F. As a general rule, the company points out that for every 20 degree increase in temperature, cleaning speed is doubled. The product is a non-dusting powder, packed in fibre drums. Company officials state that the cleaner is so effective that it will clean tars and soils that normally require a liquid solvent.

Belt Polishing Attachment

Curtis Machine Corp., Dept. MF, Jamestown, N. Y.

The new Adapt-A-Belt is one of the most universal attachments ever built and is used on a wide variety of





...and the cost is very low...

With an INDUSTRIAL demineralizer chemically pure water, in any quantity, runs as low as a few cents per thousand gallons, depending upon the amount of dissolved solids in the raw supply water. And the equipment required is very simple — no heat, steam, or cooling water is used. Units can be made to deliver almost any quantity of purified water. The operation is practically automatic — only limited attention is needed periodically.

INDUSTRIAL demineralizers are supplied with necessary equipment including resins, pressure gauge, flowmeter, purity indicator, control valves, and with vulcanized rubber lining in columns and regenerant tanks.

Standard INDUSTRIAL demineralizer units have capacities up to 1000 gph. Special units of any capacity are engineered to special requirements of quality or quantity.

Full particulars and recommendations for any job will be given upon request.

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PRESSURE FILTERS
DEMINERALIZERS
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HEAT EXCHANGERS

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Here's an easy step to CONSERVE YOUR NICKEL SUPPLY and SAVE TWO WAYS!

New Jersey Metals, with the finest melting and casting equipment available, will convert your Grade A nickel anode ends and stubs into new cast oval nickel anodes . . . cut them to specified lengths . . . drill and tap for hooks . . . and send the new anodes back to you in a matter of days.

Furthermore, you actually save 10 cents and more per pound over the cost of new anodes! All processing is under rigid laboratory control—guaranteeing the purity content of the anodes returned to be the same as that received.

99.99+% PURE VIRGIN ZINC BALL ANODES

Highest grade zinc in the most efficient shape for greatest plating surface per pound. Absolutely no contaminating matter.

ALL METAL COPPER ANODES

Cast from purest form of electrolytic copper under stringent control. No dross or blowholes.

Immediate quotation on any quantity. Laboratory analysis without obligation or charge.

Whether it's converting your nickel scrap to new nickel anodes or meeting your requirements for zinc ball and copper anodes, look to New Jersey Metals. Call Elizabeth 2-6465, or write for full information today!

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grinding and polishing operation.

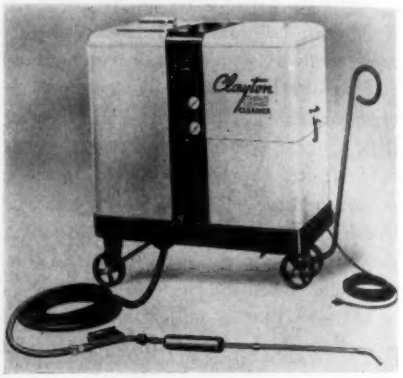
It is made for use as a portable grinder attached to an air outlet or to clamp on lathes, milling machines, drill presses or pedestal grinders to do work quickly on jobs that do not warrant setting up a machine.

Advantages of the device include the use of dynamically balanced rubber covered contact wheels in various diameters, widths, and durometer, as well as, soft or hard cloth wheels. It is of rigid light weight steel construction and offers complete simplicity in universal attaching clamps, abrasive belt tracking mechanism with efficient belt tensioning. Grinding can be done with either end or slack belt.

Model A-1 uses abrasive belts up to 1″ wide and weighs 2¼ lbs.. Model A-2 will take belts to 2″ wide and weighs 2½ lbs.

Steam Cleaning Machine

Clayton Mfg. Co., Dept. MF, El Monte, Cal.



A new high-capacity steam cleaning machine, Model LH Clayton Kerrick-Steam Cleaner, capable of discharging 150 gallons of balanced cleaning solution per hour, but offered at a price outstandingly low for heavy-duty equipment, is announced by the manufacturer.

The new unit is completely self-contained. It offers a graduated range of cleaning pressures extending from 30 p.s.i. for such jobs as paint stripping to 100 p.s.i. for the rapid cleaning of heavily encrusted or grease-coated parts and surfaces. Its carefully designed heating coil, wound in a helical pattern, provides a guaranteed thermal efficiency of 75% minimum.

A wide variety of models is available: oil-fired and gas-fired; electrically driven and gasoline engine driven; portable, stationary or trailer. Each can be optionally equipped with remote nozzle control.

Operation is simplified by the in-

clu-ion of a fuel pump designed for fast priming, and a new soap pump which eliminates any possibility of air lock in the soap line.

Automatic overheating protection is provided by thermostat controls which cut off the fuel supply to the burner in the event of excessive pressure or temperatures due to water supply failure.

The 15-gallon solution tank is equipped with water and steam inlets for ease and efficiency in mixing and dissolving the detergent concentrate. On oil-fired units, capacity of the fuel tank (fuel oil, distillate or kerosene may be used as fuel) is 13.5 gallons. Twenty-five feet of special vapor cleaning hose and an insulated swivel-handle gun with round nozzle are provided as standard equipment on all models.

The portable unit is mounted on a steel chassis equipped with four steel wheels. A drawbar makes it easy to wheel the machine to any desired location. All units are equipped with temperature and pressure gauges, valves and steam outlet grouped on a central panel for maximum operating convenience. A streamlined steel enclosure, with a hinged panel that is quickly lifted when desired, provides protection for working parts.

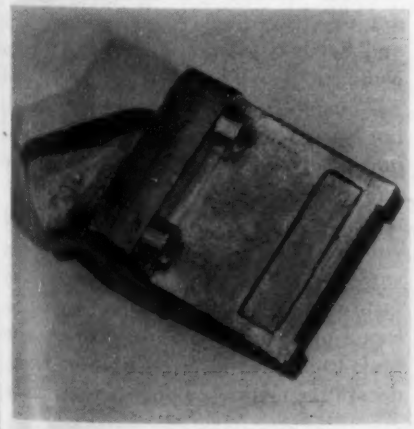
Steam Cleaning Nozzle

American Nozzle Corp., Dept. MF, 30 Church St., New York 7, N. Y.

The Steam-Blaster, a new nozzle which is expected to revolutionize steam-cleaning techniques, has been recently introduced.

Two years of testing under actual job conditions have convinced company officials that the new nozzle is up to 40% more efficient than the conventional steam nozzle. This represents a visible reduction in time and labor costs of steam cleaning or stripping, it is pointed out.

The flat nozzle has a unique patented



AUTHORIZED HONITE DISTRIBUTORS
Sales and Service

Micro Deburring Co. Chicago, Ill.
Mechanical Finishing Co. Cincinnati, Ohio
Metal Finishing Corp. Hazel Park, Mich.
Metal Parts Processing Co. Newark, N. J.
Metal Finish, Inc. Newark, N. J.
M. E. Baker Co. Cambridge, Mass.
Tumbling Products, Inc. Indianapolis, Ind.
Deburr Co. Philadelphia, Pa.
Gerell Mfg. Co. Cleveland, Ohio
Mosher Co. Chicopee, Mass.
Precision Tumbling & Supply Co. Stratford, Conn.
Sundmark Supply Co. Los Angeles, Calif.

These HONITE distributors are experts who have had years of experience in barrel finishing. Your local distributor is equipped to give you complete service on every phase of barrel finishing: equipment, Honite chips and Honite compounds.

He'll show you that HONITE is the longest-lasting, fastest-cutting natural barrel finishing abrasive available today. You'll see that no other barrel finishing abrasive—not even granite—retains its cutting edges as long as HONITE!

He'll show you why low-priced HONITE is not only best, but most economical for fine finishing to close tolerances, and for many other jobs involving a minimum amount of metal removal.

Ask about SUPER-HONITE
World's *Toughest* Abrasive Chip

Only chip engineered for *both* grinding and burnishing. Made of super-hard aluminum oxide mineral grains fused with a ceramic bonding agent. Gives high luster finish in jig time because chips never crumble or pulverize.

Write today for free copy of "3M Barrel Finishing" . . . filled with helpful information on increased efficiency, lower costs.

Address Minnesota Mining & Mfg. Co., Dept. MF83, St. Paul 6, Minn.

Name.....Title.....

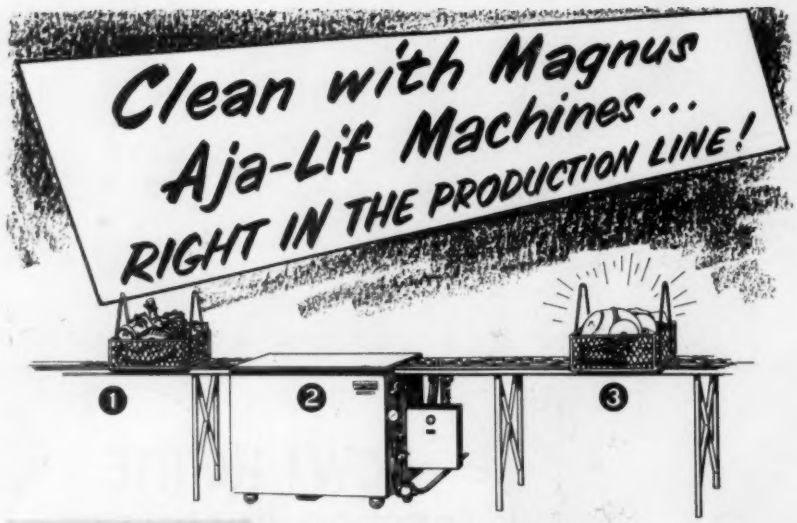
Company.....

Address.....

City.....Zone...State.....

Made in U.S.A. by Minnesota Mining & Mfg. Co., St. Paul 6, Minn.—also makers of "Scotch" Brand Pressure-Sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: 122 E. 42nd St., New York 17, N. Y. In Canada: London, Ont., Can.

3M



AJA-LIF IN PRODUCTION LINE. Work is loaded and unloaded at top of machine. 1—Dirty parts from processing; 2—Cleaning in Aja-Lif; 3—Cleaned parts to finishing.

Magnus Aja-Lif Cleaning Machines bring you all the advantages of speed and thoroughness of the Magnus Aja-Dip principle of metal cleaning. Added to the chemical action of the cleaning solution is the vigorous and effective mechanical scouring and shearing action obtained while the work is moved up and down in the solution 90-180 times a minute.

***In addition,* with the Aja-Lif Machine, you load the work on the machine at waist level. When you press the starting button, the platform drops as the cover closes, and agitation starts. When ready to unload, the machine stops and the platform returns to waist level. The machine fits perfectly into the production line!**

COMPRESSED AIR OPERATED . . . no gears, speed reducers or belts. No motors or electrical connections. Heating source to meet your needs.

WRITE FOR BULLETIN AL-701, containing the complete story on this unique metal cleaning machine.

MAGNUS CHEMICAL CO., INC.
11 South Ave., Garwood, N. J.
In Canada: Magnus Chemicals, Ltd., Montreal
Service Representatives in Principal Cities

magnus

center blade. This feature gives the user a hard-hitting impact.

The nozzle blade reduces the effect of eddy turbulence at the orifice of the nozzle and creates a pressure differential between the two flat planes of steam. This phenomenon produces a knife-like cutting action at the point where the planes converge. The flow is completely non-divergent, assuring maximum impact and minimum waste of pressure.

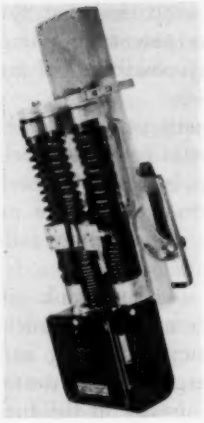
Ruggedly constructed, with a bronze body and stainless steel blade, the less-than-24-ounce nozzle can be used with detergents, if desired. It can be used with a straight or 45 degree union, has a 1½" by .04" orifice, and ½" pipe thread. Replacement parts are available.

Buffing Compound Applicator

George L. Nankervis Co., Dept. MF, 19255 West Davison, 23, Mich.

A new air-operated buffing compound applicator that features a variable number of applications per minute is announced by the manufacturer. Designated as the "600" Series, the new applicator is available in four models to accommodate rectangular or round compound bars.

The new applicator can be installed on all types of buffing machines from simple lathes to multi-operation automatics. Light weight construction, less than 18 pounds, permits installation on floating heads without disturbing balance. It can be installed in any position without effecting operation.



Key feature of the new applicator is its ability to feed any number of strokes per minute . . . applying compound only when required. For example, it can be installed so as to apply compound only during the buffing cycle, withdrawing while the work changes from station to station in the machine. In addition, it is also possible to operate up to eight applicators simultaneously from a single controlling valve, applying compound uniformly to all buffs. With each application, the compound is fed forward to compensate for "wear down" of the bar. The rate of feed is adjustable from .0015" to .015" per stroke.

Major parts of the applicator are fabricated of cast aluminum to minimize overall weight. All operating parts are covered to seal out dirt, wheel lint and compound. Moving parts are bearing mounted to insure trouble-free service and smooth operation.

Savings in buffing costs up to 40% have been reported by users through increased buff life, compound savings, and reduction in labor. A technical bulletin describing the new applicator is available upon request.

Improved Flooring Resists Oil & Grease

United Laboratories, Inc., Dept. MF, 16801 Euclid Ave., Cleveland 12, O.

Development of an improved oil and grease resistant flooring has been announced by the company. Known as Sylox, the product is a type of oxychloride cement that is highly resistant to absorption of oil, grease, fats and solvents of many kinds. It is a complete flooring "unit" in itself and no outside ingredients need be added, not even water. Each "unit" is proportioned and packaged at the factory and is designed to cover a pre-determined area at an average depth of only one-half inch. The product has varied uses in industrial plants and institutions where oil and grease present a problem. In addition, Sylox also finds usefulness in areas where a semi-decorative service floor is desirable.

BUSINESS ITEMS

Minnesota Mining Appoints Distributor

Appointment of *Metals Finishing Corp.*, 836 East Tenmile Road, Hazel Park, Mich., as distributor for the Honite line of barrel finishing equipment and products has been announced by the manufacturer, *Minnesota Mining and Mfg. Co.*, St. Paul, Minn.

The firm, headed by *Harvey Beggs*, president, has operated a barrel finishing shop for the past eight years. Sales manager for the company is *Cranston Jones*.

Among services provided in adjacent areas of Ohio and Indiana as well as Michigan are engineering and sample processing to determine proper application of the barrel finishing process in a customer's plant; sales engineering of complete barrel finishing installations; and job shop or custom barrel finishing work.

Dr. Hiram S. Lukens Retires From Active Teaching

Dr. Hiram S. Lukens, Blanchard Professor of Chemistry at the University of Pennsylvania, in Philadelphia, retired from active teaching June 30 after 46 years on the faculty.

National president of the *Electrochemical Society* in 1934-35, he was acting dean of the University's Towne Scientific School in 1937-38, director of its department of chemistry and chemical engineering from 1932 to 1951 and head of the chemistry department in 1951-52.

Dr. Lukens, author of a score of published articles, holds 23 American, Canadian, British and German patents.

Beeson Named Sales Manager of Belle Alkali

William B. Beeson, Jr., of Pittsburgh, Pa., a veteran member of the *Diamond Alkali Co.* sales organization, has been named sales manager of Diamond's new subsidiary, *Belle Alkali Co.*, of Belle, W. Va.

Mr. Beeson's sales career with Diamond, dating back to 1933, was interrupted only by World War II, when he served as a major in the U. S. Army Air Corps. Originally assigned to the company's Cincinnati branch sales office, he was transferred in March, 1948, to the company's Pittsburgh branch office, where shortly thereafter he was promoted to the position of assistant branch manager.

Born in Uniontown, Pa., Mr. Beeson attended public schools there before enrolling at Mercersburg Academy, Mercersburg. After graduation he attended Washington and Jefferson College, Washington, Pa., where he received an A.B. degree in 1932.

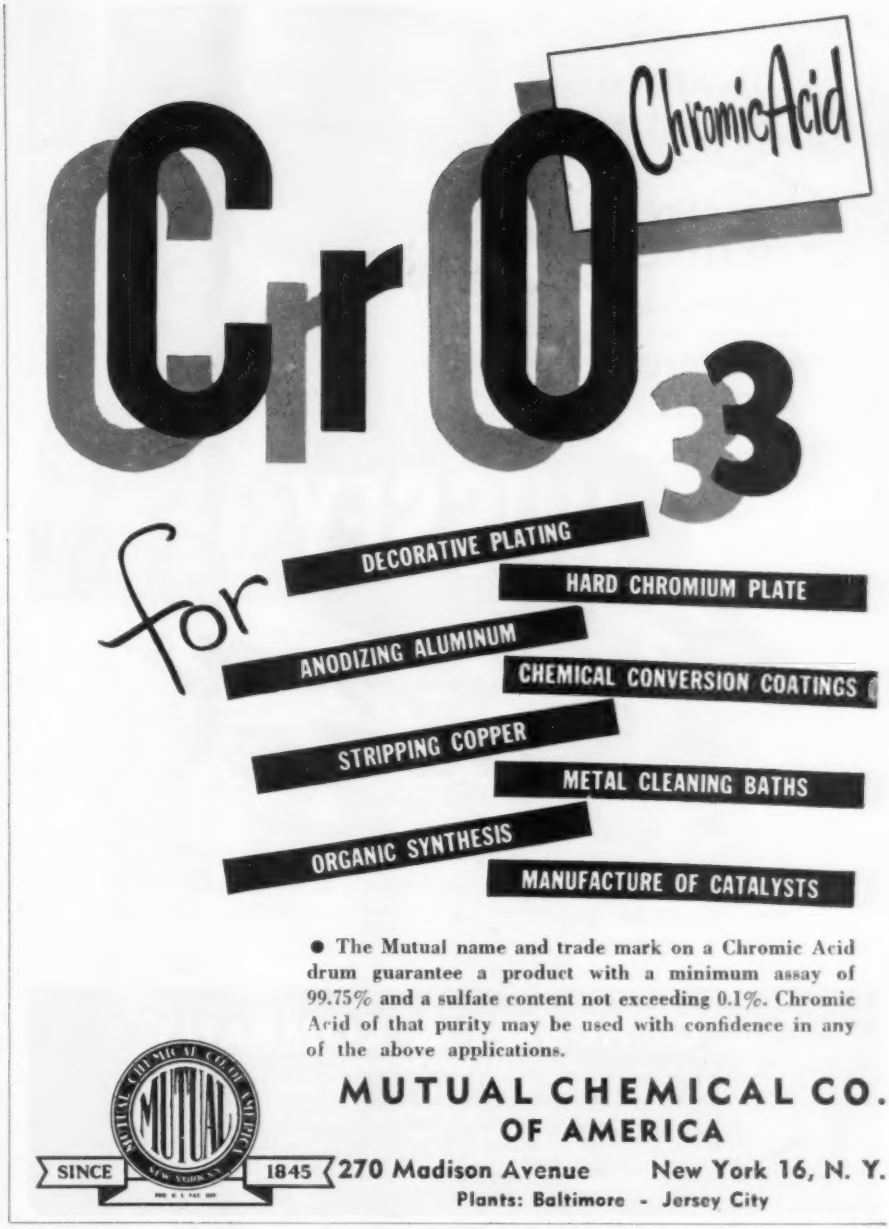
Officers Elected by Cambridge Wire Cloth

The Cambridge Wire Cloth Co., Cambridge, Md., has announced the following new officers, recently elected by the board of directors:

Clarence Edward Pink, chairman of the board and chief executive officer; *Edward N. Evans*, president; *Irwin F. Pink*, senior vice-president; *Fred L. Hooper*, executive vice-president; *Harold E. Pink*, secretary and *Nina E. Pink*, treasurer.

Carborundum Announces Personnel Changes

F. W. Bonacker, general sales manager of the *Industrial Abrasive Sales Division* of *The Carborundum Co.*, Niagara Falls, N. Y., has announced several personnel changes. Among the changes are three retirements: *George S. Rogers*, Buffalo district sales manager with 37 years of service; *William T. O'Mara*, general salesman, Buffalo sales district with 41 years; and *Samuel Phipps*, general salesman, St. Louis district after 35 years of service with the company.


CrO3
Chromic Acid
for
DECORATIVE PLATING
HARD CHROMIUM PLATE
ANODIZING ALUMINUM
CHEMICAL CONVERSION COATINGS
STRIPPING COPPER
METAL CLEANING BATHS
ORGANIC SYNTHESIS
MANUFACTURE OF CATALYSTS
● The Mutual name and trade mark on a Chromic Acid drum guarantee a product with a minimum assay of 99.75% and a sulfate content not exceeding 0.1%. Chromic Acid of that purity may be used with confidence in any of the above applications.
MUTUAL
SINCE 1845
MUTUAL CHEMICAL CO. OF AMERICA
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Plants: Baltimore - Jersey City

Here are the basic tools for real craftsmanship in electroplating. Available in a full range of shapes and sizes, Hussey Pure Copper Anodes assure uniform finish and fast, dependable plating. For fastest service call the Hussey warehouse nearest you.

C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES, PITTSBURGH 19, PA.
7 Convenient Warehouses to serve you promptly!

PITTSBURGH ..... 2850 Second Avenue
CLEVELAND ..... 5318 St. Clair Avenue
NEW YORK ..... 140 Sixth Avenue
CINCINNATI ..... 424 Commercial Square
CHICAGO ..... 3900 N. Elston Avenue
ST. LOUIS ..... 1620 Delmar Boulevard
PHILADELPHIA ..... 1632 Fairmount Avenue

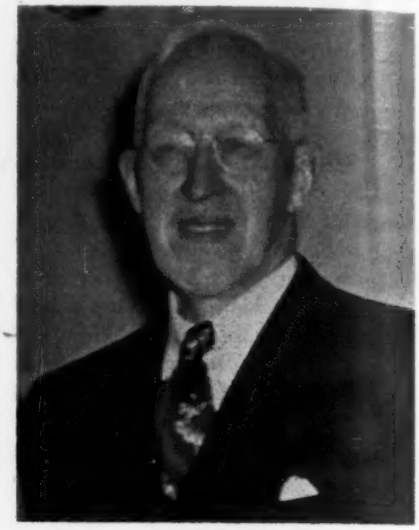
George H. Dennison was moved up from assistant to Buffalo district sales manager. *William G. Kettner, Jr.* was promoted from assistant to office manager for the New York sales district. *C. R. Strong*, a general salesman in the Chicago sales district, who serviced a territory in Wisconsin was transferred to the Peoria, Ill. territory and will sell both bonded and coated abrasives in that area. *F. H. Garske, Jr.*, *A. G. Ott* and *J. H. Spehr* will service the Wisconsin territory formerly served by Strong.

M. I. Johnson, formerly bonded field sales engineer in the Buffalo district, was made general salesman and will service the territory formerly served by O'Mara in the Buffalo district. *G. A. Tanner*, graduate sales trainee, was promoted to general salesman and assigned to the territory formerly covered by Phipps in the St. Louis district. *H. A. Johnson*, a coated abrasive salesman in the St. Louis district, was assigned the South Texas coated abrasive territory formerly serviced by *S. E. H. France* who was transferred to the New York sales district. *H. W. McGarr*, formerly a coated abrasive salesman for the DesMoines-Davenport territory, was transferred to the Chicago District. The territory previously serviced by McGarr will now be served by *R. D. Hulben* and *Strong*.

Dr. William Blum Receives Honorary Degree

Dr. William Blum, with the U. S. Bureau of Standards from 1918 until his recent retirement, received the honorary degree of Doctor of Science from the University of Pennsylvania at its 197th Commencement on the campus in Philadelphia on June 10.

The honor came just 50 years after Dr. Blum's graduation from the University in 1903 with the degree of



Dr. William Blum

bachelor of science in chemistry.

Dr. Blum taught chemistry at the University of Utah from 1903 until 1909, in which year he earned a Ph.D. degree at Utah and relinquished an assistant professorship in order to join the service of the Bureau of Standards.

In 1926 he received the Medal of the Institute of Chemists for distinguished governmental service, and in 1944 he was awarded the Edward Goodrich Acheson gold medal and prize for his contributions to the field of electrochemistry.

Westinghouse Breaks Ground for New Research Center

Westinghouse Electric Corp. has broken ground for a new research center in the electrical industry. *Dr. John A. Hutcheson*, vice-president and director of research, turned the first shovelful of earth at a ceremony held on a 70-acre plot about 10 miles east of downtown Pittsburgh's Golden Triangle.

The new research center will be housed in an "L"-shaped, three-story building. Coordinating the design and construction of the new laboratories is *Dr. C. R. Hanna*, associate director of the Westinghouse research laboratories.

The new research center will ultimately replace the present research laboratories located since 1916 only a few miles away from the new site. Of the present staff there only a small number will remain behind when it comes time for "the big move." For the time being, those who stay on at the old labs will continue research involving the use of special equipment such as that in the combustion laboratories, the 90-ton atom smasher and other equipment impractical to move. The giant, pear-shaped Van de Graaf generator, a familiar sight to motorists entering or leaving Pittsburgh's eastern city limits, will also remain at the old site.

Martin Appointed Kelite National Sales Director

L. C. Sorensen, president of *Kelite Products, Inc.*, manufacturers of industrial cleaning and processing chemicals, has announced the appointment of *Richard C. Martin* as national sales director. Martin will supervise the company's service offices in 84 cities.

Martin started with the company in 1944 and in 1950 was put in charge of the Southern Division with headquarters in Dallas. A native Texan himself, Martin expanded business so rapidly throughout Missouri, Kansas, Oklahoma, Louisiana and Texas that

Richard C. Martin

he is now put in charge of the entire sales operation. Martin will make his headquarters at the Kelite main plant, 1250 North Main Street, Los Angeles.

Oakite Announces Changes

Following a recent meeting of the board of directors of Oakite Products, Inc., manufacturers of industrial cleaning and allied materials, five changes in the management organization of the company were announced. *H. Liggett Gray*, former vice-president, was elected to the office of second vice-president, in which position he will have broad responsibilities in matters pertaining to over-all management functions, in addition to general supervisory duties in connection with manufacturing operations. At the same meeting, *Frank L. Oldroyd* was named vice-president, a post he will hold in addition to his present position as general sales manager of the company's industrial division. Also elected vice-presidents were *Eustace Lingle* and *Van Dorn C. Smith*. The former will continue to cooperate with the general sales manager in the direction and guidance of the firm's sales organization, and will be responsible for the functioning of its engineering, technical service and sales development departments, while the latter's duties will involve consultation work of a general technical and sales nature. Another change announced was the election of *George M. Seib*, assistant manager, to the office of secretary of the company. In addition to his new duties, he will continue to supervise personnel department operations and be responsible for general office administration policies and procedures.

Pacific Division Added by Engelhard Industries

Charles W. Engelhard, president of

Hammond OF KALAMAZOO
GOOD MACHINERY SINCE '82

MODERN Self Contained GRINDER-POLISHER

Hammond Variable Speed (1500 to 3000 RPM) Polishing and Buffing Lathe. Models up to 50 HP available.

Hammond Cyclone Duskolector. One of a wide line of Cyclone and Filter Types.

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Write for Catalog No. 60 showing America's most modern and complete line.

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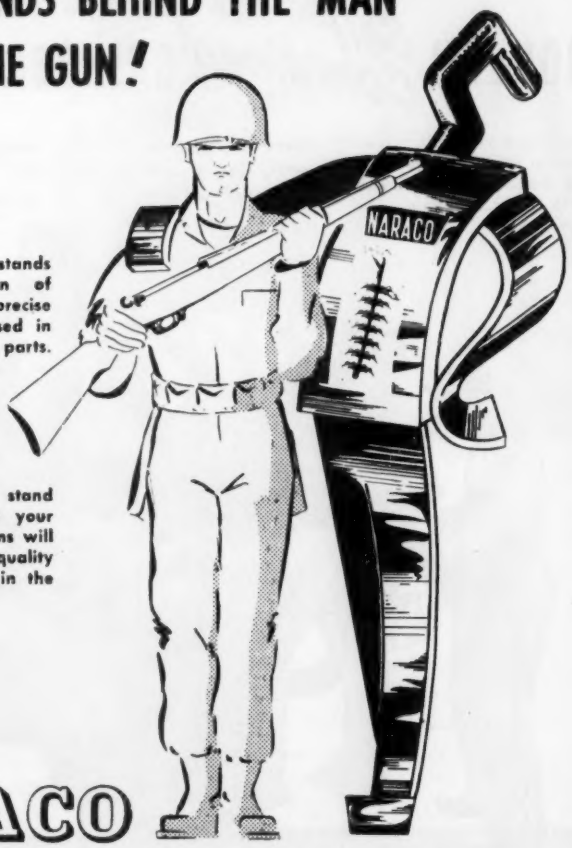
naraco STANDS BEHIND THE MAN BEHIND THE GUN!



Behind every soldier stands NARACO's reputation of making the most precise racks and fixtures used in the plating of gun parts. Without the proper plating of these parts the equipment of our armies would not survive under battle tests. Why don't you permit NARACO to stand behind you so that your production of munitions will achieve the high quality needed by our men in the armed forces.

NARACO

NATIONAL RACK CO. 179 Madison Street Paterson, N. J.
IMPERIAL RACK CO. 1109 E. Stewart Ave. Flint, Mich.
AMERICAN RACK CO. 703 W. Root St. Chicago, Ill.
INDUSTRIAL RACK CO. 3462 San Fernando Rd. Los Angeles, Cal.

Baker & Co., Inc. and of the other companies in the Engelhard Industries group, announced recently the establishment of a Pacific Division with headquarters in San Francisco and an office in Los Angeles. The purpose is to co-ordinate and expand the sales and service activities of seven companies of the group in the growing markets of the West Coast, he said.

Baker & Co., the world's largest refiners and distributors of precious metals, has maintained a San Francisco office for more than a quarter century. *Hanovia Chemical & Mfg. Co.*, makers of ultraviolet lamps and other products, has been represented there for a shorter period. With these as the nucleus the Pacific Division will be expanded to include five other companies in the Engelhard group.

They are *The American Platinum Works*, leading manufacturers of silver in all forms for industry and the arts, as well as refiners of the platinum metals; *Amersil Co.*, manufacturers of fused quartz for industrial and laboratory uses; *Charles Engelhard, Inc.*, manufacturers of pyrometers and other measuring devices; *Irving Smelting & Refining Co.*, gold refiners and manufacturers of copper sulphate, and the *D. E. Makepeace Co. Division* of *Union Plate & Wire Co.*, manufacturers of rolled gold and gold filled products for the jewelry and optical industries.

With the exception of the Makepeace Co. which has its plant in Attleboro, Mass., all these companies are based in the Newark area.

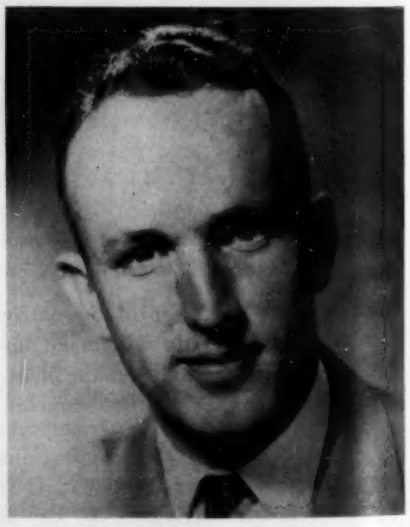
The American Platinum Works will continue to distribute its Silvaloy brazing products through *Pacific Metals Co., Ltd.*, of San Francisco, in Arizona, California, Nevada, Utah and Hawaii, and Hawaii, and through the *Eagle Metals Co.* of Seattle, in Idaho, Oregon, Washington and Alaska.

Thomas G. Ferruggia, who has been appointed general manager of the new division, will make his headquarters at 760 Market St., San Francisco; and *William Schmidt, Jr.* will be in charge of an office at 1111 Wilshire Blvd., Los Angeles. Mr. Ferruggia joined the Hanovia company in 1936. Following ten years in sales and other executive capacities, he has spent the past four years assisting in the formation of Engelhard companies and agencies in South America and Australia. Mr. Schmidt has been with The American Platinum Works for the past ten years in various sales positions.

H-VW-M Appoints Two New Eastern Representatives

Hanson - Van Winkle - Munning Co., Matawan, N. J., manufacturers of electroplating and polishing equipment & supplies, announces the appointment of two new eastern sales representatives: *W. M. Teets* as representative for the New Jersey area and *Robert Morriss* as representative for the New York metropolitan area.

Mel Teets moves over to New Jersey from the metropolitan area where he has been a representative for H-VW-M for the past two years. Prior to that time, he spent a year in training at the company laboratory at Matawan. He is a graduate of Lafayette College,



W. M. Teets

Robert Morriss

B.S. in Electrical Engineering, 1949, and served in the USAAF during World War II.

Morriss moves down to New York from Stratford, Conn., where he was manager of the H-VW-M warehouse for four years. He formerly worked in the purchasing department as a buyer, and has been with the company for seven years.

Appointments Announced by General Electric

Eight men have been named to key industry sales posts in the *General Electric Company's Apparatus Sales Division*, according to a recent announcement by *K. H. Runkle*, manager of industry sales.

They are: *O. B. Falls, Jr.*, manager of electric utility sales; *T. F. Mackey*, manager of heavy industries sales; *K. R. Ross*, manager of medium industries sales; *W. V. Gough*, manager of light industries sales; *H. R. Wallrath*, manager of contractor and construction industries sales; *A. H. Hemker*, manager of farm, trade, and services industries sales; *H. D. Beale*, manager of industry products maintenance; and *F. W. McChesney*, manager of industry sales procedures.

All will be located at division headquarters in Schenectady, N. Y.

Reynolds Metals Names New Detroit Distributor

Appointment of *Meier Brass & Copper Co.*, 2971 Bellevue Ave., Detroit, Mich. as a distributor of Reynolds aluminum has been announced by *Reynolds Metals Co.* through its general sales office in Louisville, Ky. Meier will stock aluminum wire, rod, and bar in standard alloys and tempers. The firm also will handle aluminum cast plate and bar for tools, dies and fixtures in a wide range of sizes.

Meier is completely equipped to provide prompt service on these items. The new appointment will increase the availability of these aluminum products in the Detroit area.

Stonoga Joins Utility

Ben Stonoga has recently been appointed director of sales for *Utility Chemical Co.*, Paterson, N. J., manufacturers of metal cleaners and sanitation chemicals.

He has wide experience in various cleanser fields having formerly held various sales executive posts with Virginia-Carolina Chemical Corp., Richmond, Va., and Klenzade Products, Inc., Beloit, Wis.

International Nickel Elects J. Roy Gordon

J. R. Gordon has been elected vice-president and general manager of Canadian operations of *The International Nickel Co. of Canada, Ltd.*, succeeding the late *R. Leslie Beattie* in both capacities, it was announced today by *Dr. John F. Thompson*, chairman of the board of directors of Inco.

Mr. Gordon has been an assistant vice-president since December, 1947, and in addition was appointed in May, 1952, assistant general manager of the company's Canadian operations under Mr. Beattie.

Born on a farm near Kingston, Ontario, he graduated from Queen's

NO DOUBLE-TALK

One big advantage in doing business with an owner-managed company like ours is that you can always get a prompt, unequivocal answer to any legitimate question. Our quotations on price, quantity and delivery are as consistently dependable as the quality of BFC Chromic Acid. And that is always above the industry standard for purity.

We think you'll like the uniform quality of our product and the friendly way we do business whether the market is long or short. Why not get in touch with us when you need Chromic Acid?

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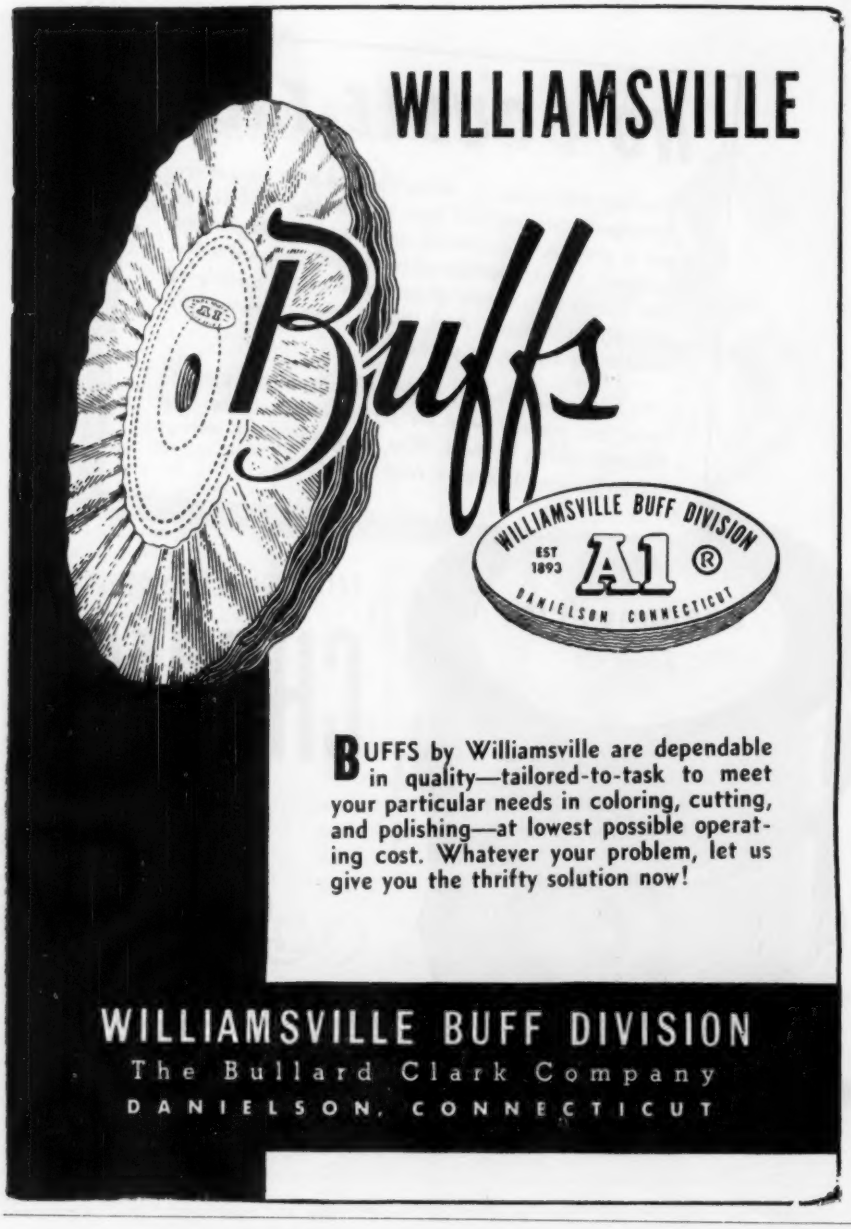
WILLIAMSVILLE
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BUFFS by Williamsville are dependable in quality—tailored-to-task to meet your particular needs in coloring, cutting, and polishing—at lowest possible operating cost. Whatever your problem, let us give you the thrifty solution now!
WILLIAMSVILLE BUFF DIVISION
The Bullard Clark Company
DANIELSON, CONNECTICUT

University in 1920 with the degree of Bachelor of Science in Chemistry. He was associated from 1920 to 1929 with M. J. O'Brien, Ltd., as a research metallurgist. From 1929 to 1936 he was with the Ontario Research Foundation at Toronto and during the later years served as its assistant director of metallurgy.

He joined Inco in 1936 when he was appointed director of the research department established in that year at Copper Cliff, Ontario. Mr. Gordon was made an assistant to the vice-president in 1941 and technical assistant to the vice-president in 1946.

He is a member of the Canadian Institute of Mining & Metallurgy, the American Institute of Mining & Metallurgical Engineers, the American Society for Metals and the Chemical Institute of Canada and was the recipient of the 1948 Medal of the Canadian Institute of Mining & Metallurgy "for his contributions to process metallurgy in the smelting and refining of nickel, and improvements in metallurgical nickel recovery."

Houghton Labs. Adds to Staff

Russell M. Houghton, president of *Houghton Laboratories, Inc.*, of Olean, N. Y., manufacturers of Hysol products, has announced the recent appointment of two new representative organizations in Ohio and Canada.

The Servisales Co., 14327 Detroit Ave., Cleveland, has been appointed for Ohio with three representatives, *W. Mossman, C. Woneman and A. Geldhof.*

In Toronto, the *John S. Plewe Co.*, 52 Humbercrest Blvd., will be representative for the company's products.

H-VW-M Appoints New Chicago Representative

Hanson - Van Winkle - Munning Co., Matawan, N. J., manufacturers of electroplating and polishing equipment & supplies, announces the appointment of *Henry G. Zucker, Jr.*, as sales representative in the Chicago area.

Zucker, who is a graduate of Lafayette College, received extensive technical training at the H-VW-M laboratory following his graduation in 1949. He received additional training in sales at Matawan prior to coming to the Chicago office.

Henry G. Zucker, Jr.

Fanner Mfg. Co. Acquires Munray Products

C. Grief Raible, president of *Fanner Mfg. Co.*, Cleveland, Ohio, announces the expansion of that company into the plastics industry with the purchase of *Munray Products, Inc.*, Cleveland, Ohio, manufacturers of many types of plastics including plastic pipe, plastic tank linings, plastic coatings, etc.

William Munkacsey, who founded Munray in 1947, remains as president and general manager of that company and will be in charge of Fanner's plastic activities.

The consolidation of these two companies will give Fanner a firm standing in the rapidly growing plastic industry. It will benefit Munray by making available additional capital for enlarging facilities for manufacture of their products with special opportunity to expand production in the

plastic pipe, plastic tank lining and protective coatings fields.

Munray Products, Inc. will continue in business in their present location at 12400 Crossburn Ave., Cleveland 11, Ohio.

U. S. Stoneware Appoints Bullock

Howard Farkas, vice-president and general sales manager of *The U. S. Stoneware Co.*, Akron, Ohio has announced the appointment of *Kenneth L. Bullock* as assistant sales manager

Kenneth L. Bullock

of *The Process Equipment Division*, with headquarters in the Akron office.

Mr. Bullock holds the degree of Bachelor of Science in Organic Chemistry from the University of Delaware, and is a member of the *American Chemical Society*. He has had wide experience in chemical processing, having specialized in the field of organic chemicals. He has been prominent in research and development of phenolic and furane resins for application in chemical resistant plant equipment.

Marsh Elected Vice-President of Inco

John A. Marsh, assistant vice-president and manager of operating department of *The International Nickel Co., Inc.*, has been elected vice-president of the company, according to an announcement by *Dr. John F. Thompson*, chairman of the board of directors. Mr. Marsh is in general charge of all plant operations in the United States.

Born in Lake Bluff, Illinois, Marsh became associated with the company as a laboratory assistant in its Huntington, W. Va. Works following his graduation from the University of Michigan in 1928. He was transferred to the Bayonne, N. J. Works of the company as assistant superintendent in January, 1936. In August of the same year he became general superintendent of the Bayonne Works. He was named general superintendent of the Huntington Works in September, 1942, and in June, 1944, was promoted to assistant general manager.

In June, 1947, he was appointed assistant to the vice-president in general charge of all plant operations of the company in the United States and was transferred to the New York Office. He was named manager of the operating department in January, 1952, and was elected an assistant vice-president in May of the same year. Mr. Marsh was placed in general charge of all plant operations in the United States, succeeding in that capacity the late *Hugh J. Fraser*.

Ransohoff Moves to New Plant

N. Ransohoff, Inc., producer of equipment, for surface treatment of metals, recently undertook one of the most important steps in the 36-year history of the company and its development when it moved from its original location in Elmwood, a Cincinnati, suburb, to a much larger, completely modern plant in Hamilton, Ohio.

The move provides the company with many advantages in greatly enlarged production facilities, and the consolidation of all administrative, en-

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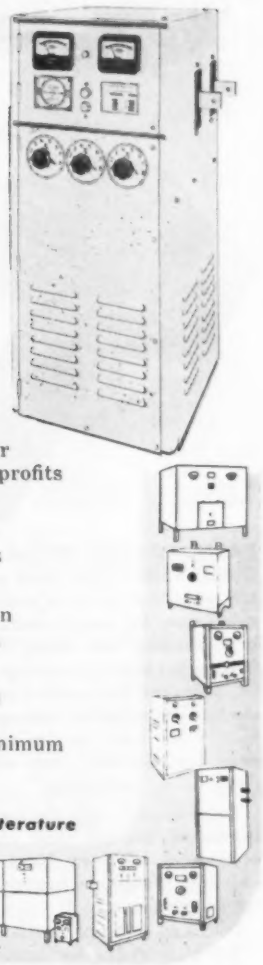
an unfailing D-C SUPPLY for quality plating



For increased production, improved quality, fewer rejects, lower labor costs—which translates into higher profits—use Richardson-Allen dependable rectifiers.

The basic R-A Rectifier is widely used where a single voltage or current is needed or where several rectifiers are to be paralleled.

For electroplating chrome or bright nickel a 22-position tap switch is supplied. For electroplating gold or silver, and for anodizing a 36-position tap switch is used.

A special Heat Exchanger unit is available for use in corrosive atmospheres. This R-A development permits operation at elevated ambient temperatures with a minimum temperature rise. Long, uninterrupted, dependable service is assured.

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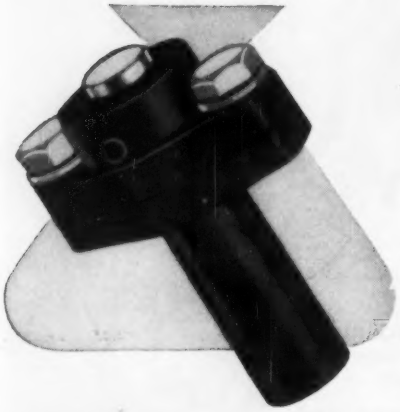

BARNABY MFG. CO. of Bridgeport, Conn., reports: "Our close proximity to salt water has given us problems in rust prevention for many years. We have experimented with many black oxide finishes but none has proven as successful, safe, and inexpensive as DU-LITE—our tools have better sales appeal—our volume has been on the increase ever since we started using this modern, progressive oxide finish."

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- Phosteel and Phospray for phosphatizing steel, iron or zinc.
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- Dynakleen for bright cleaning all metals.
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Or send us samples of parts and we will process them for your approval.

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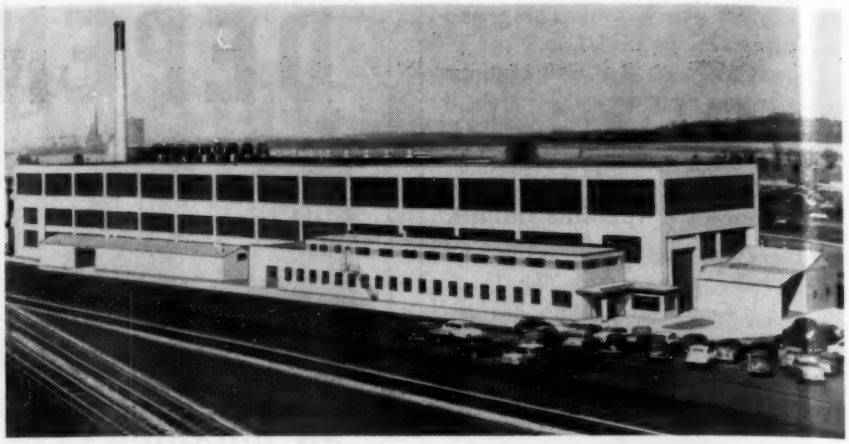
METAL FINISHING SPECIALISTS



gineering, experimental, and sales departments in one location.

Even though the post office address has been changed from Cincinnati to Hamilton, the change of location involved a move of but a few miles and has had no effect on the retention of key personnel, or experienced engineers and mechanics.

The principal component of the new plant is the expensive fabrication shop with a pillarless interior as large as a football field. Two large capacity traveling cranes serve the entire shop area. Railroad cars and trucks can load, or unload, inside the shop. One adjoining building houses a well-equipped machine shop.

Kaye-Tex Manufacturing Adds New Division

Irving Korn, president of *Kaye-Tex Mfg. Corp.* announces the formation of *Kaykor Industries, Inc.*, a new division to handle the manufacture, sale, and technical service of rigid polyvinyl chloride, styrene copolymers, and other industrial type thermoplastic plates, sheets, pipe, pipe fittings, which are designed for use on both functional as well as decorative applications.

The operation of Kaykor Industries will be directed by *V. C. Pierce*, vice-president, with *J. L. Huscher* as manager of technical sales and service.

Sales and technical service activities will be conducted from the company's plant, located at Yardville, N. J.

Federated Appoints Murphy

Federated Metals Div. of *American Smelting & Refining Co.* announces the appointment of *Charles Murphy* representative of the midwestern plating and electrochemicals department. He will serve the entire midwestern

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METAL CLEANERS AND BURNISHING COMPOUNDS
HAY CHROME SALTS—Increases Chrome Throwing Power
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department in a sales and service capacity and will have headquarters in Whiting, Ind.

Mr. Murphy comes to Federated after 12 years service with the *Plating Products Co.* of Newark, N. J.

Fred Fraley Retires

Fred W. Fraley retired July 1 as a vice-president of *Diamond Alkali Co.*, it was announced at company headquarters recently. He resigned recently as a director of the company.

Mr. Fraley's 25-year career with Diamond began in 1928 as manager of the company's Southwest sales office in Houston, Tex. In 1943 he became vice-president sales, and has served as a director since 1947. He was also a director and former vice-president of *The Chlorine Institute.*

Always active in the chemical industry's relationship with the government, he recently served with the *National Production Authority* under the "loan" plan whereby industry executives are recruited for temporary periods. At the time he concluded his nine months of service in December of 1952, Mr. Fraley was assistant administrator of N.P.A. in charge of the Chemical, Rubber & Forest Products Bureau. During World War II, he was a member of the W.P.B. and Munitions Board industry advisory committees.

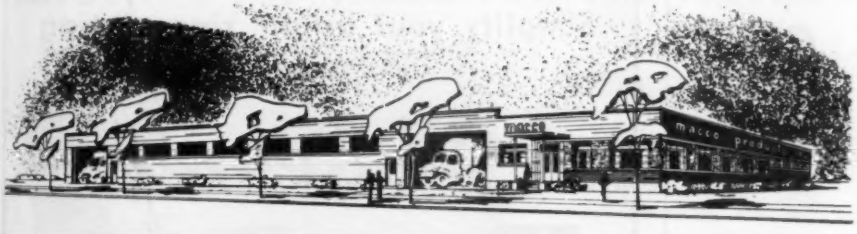
Macco Building New Quarters

Starting business in 1931 in a two-car garage and having since moved to larger quarters three different times, the *Macco Products Co.* is now in the process of building a modern, new plant. The location is a square block between 92nd and 93rd streets on Sangamon St., Chicago.

G. A. Cairns, general manager, reports that the new building is to be a one-story brick structure. It will have 40,000 sq. ft. of floor space and will afford 150% additional production capacity. One of the principal features will be the new plant's fire and explosion-proof compounding room, which will be the most modern to be found in the industry.

Designed with receiving department at one end and the shipping department at the opposite end, the building has been planned so that there will be a constant, uniform flow of processed material going through the plant.

The company produces special draw-



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THE Chemical CORPORATION

58 Waltham Ave., Springfield 9, Mass.

ing and cutting oils, cleaning and rust-proofing solutions, and many other highly efficient compounds for steel processing. The new plant is to be ready for occupancy this fall.

Samuel Wein Married

Samuel Wein, consulting engineer in connection with electroplating on plastics, and author of the book, *Metallizing Non-Conductors*, was recently married to *Miss Sayde A. Berman*. Mr. Wein is now operating as a consultant out of 98 Bigelow St., Quincy, Mass., and Miami Beach.

Copies of the book, Metallizing Non-Conductors, are available through this publication.

Manufacturers' Literature

Filters and Processing Equipment

Alsop Engineering Corp., Dept. MF, 800 Bright St., Milldale, Conn.

A new 32-page catalog has been written especially for the plant personnel. It contains photos, diagrams, some full page size, and comprehensive information on the entire Alsop line of stainless steel liquid processing equipment, including filters, filter discs, mixing and storage tanks, portable mixers, fixed-side and top-entering agitators and transfer pumps.

The catalog treats each product separately, their features are described clearly and completely with an explanatory text, numerous plant installation illustrations, design variations, detail drawings and parts lists, application and performance data. The catalog also makes known the services of the Alsop Engineering Staff to design special units which might be required to fit the customer's specific job.

Preparation of Light Metals for Welding

Northwest Chemical Co., Dept. MF, 9310 Roselawn, Detroit, Mich.

The above manufacturers of specialized chemical cleaners announce a new 12-page brochure completely describing their Alkalume process, for preparing aluminum, magnesium, and hard-to-clean steels for welding, and other finishing operations. The product cleans without harming the metal, dissolves and removes the surface oxides, reduces the surface resistance to a value of 0 to 10 microhms, and preserves for long periods of time a surface resistance between 10 to 20 microhms.

Nickel-Lined Pipe Booklet

Bart Mfg. Corp., Dept. MF, 227 Main St., Belleville 9, N. J.

"Positive Corrosion Control" is the title of the new 8-page booklet published by the above firm. Illustrated with many typical samples of nickel-lined pipe, fittings and flanges, the booklet discusses the exclusive Lectro-Clad process and uses for nickel-lined steel pipe for corrosion protection. Included in the material are test results gathered over a period of 10 years in various installations, as well as descriptions of applications in the petroleum fields, organic and inorganic chemical industries, pulp and paper production and the handling of corrosive materials generally.

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3. Minimize need for decanting or filtering.
4. Precipitate excessive carbonates.
5. Reduce Brightener consumption.

Try a 5-gallon can, $15.00; or a 15-gallon drum, $42.75, on 30 days' approval.

Sulphur Products Co. Inc.

Greensburg 7, Pa.

Properties of Electrodeposited Nickel

The International Nickel Co., Inc., Dept. MF, 67 Wall St., New York 5, N. Y.

Bulletin A-153 — 5 pages, illustrated, is an extended abstract of a report of a 5 year investigation sponsored by the *American Electroplaters Society* and carried out at the *National Bureau of Standards*. It discusses, in a general way, uses; baths and types of deposits; and, specifically, properties of deposits and the variables that influence them; composition and structure of deposits. The results of this study are of interest to users and producers of nickel plating for (a) electroformed shapes, (b) building up worn or over machined components and (c) heavy industrial coatings that impart nickel's corrosion resistance to common materials of construction.

Mixed-Bed Demineralizer Bulletin

Barnstead Still & Sterilizer Co., Dept. MF, 2 Lanesville Terrace, Forest Hills, Boston 31, Mass.

The company announces the publication of a new bulletin, No. 126, on mixed-bed water demineralizers, which explains in text and pictures how a mixed-bed demineralizer operates in producing high-purity water by ion-exchange method. The manufacturer now has a full line of mixed-bed demineralizers in addition to their 2-bed and 4-bed models.

Special stress is laid on the recent development of a simplified, positive regeneration system, which separates resins quickly and surely and then remixes them for efficient mixed-bed performance.

Ion Exchangers

The Permutit Co., Dept. MF, 330 West 42nd St., New York 36, N. Y.

While ion exchange is not a new process, it is finding many new uses and is rapidly attracting attention in all phases of industry. Engineers and chemists are using cation and anion exchangers in hundreds of applications where previously available techniques were inadequate. They are being utilized for the removal of impurities from solution; concentration of electrolytes in solution; addition of specific ions to solution; separation of electrolytes in solution; catalysis and in special medical applications.

To summarize the properties of most of their ion exchangers and indicate some of their uses, a 12-page bulletin (No. 2508) has been prepared by the company.

The bulletin details a general history of ion exchange engineering, gives data on the proper selection of ion exchangers and lists general applications in the treatment of water and special problems associated with the recovery of valuable metals from solutions, streptomycin purification, sugar refining, separation of rare earths, treatment of wastes, etc.

Chart Shows Corrosion Resistance of Cements

Pennsalt Chemicals, Dept. MF, 1,000 Widener Bldg., Philadelphia 7, Pa.

The Corrosion Engineering Department of the company has prepared a comprehensive chart showing the resistance of seven classes of corrosion resistant cements to 297 of the most generally used corrosive chemicals.

The chart indicates that the company has a cement mortar which is resistant to the chemical attack of

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Catalog Section S-7250 Contains:

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every one of these chemicals except sodium hypochlorite which, being an oxidizing agent on the alkaline side, will attack most materials at certain temperatures.

The type of cement mortars listed in the chart are: Silicate — Penchlor; resin type — Pennsalt Furan, Pennsalt Asplit, Pennsalt HF and Pennsalt PRF; and Sulfur — Pennsalt Sulfur and Pennsalt Carbon Sulfur.

It is pointed out that the new chart is intended only as a ready guide for engineers, construction and maintenance men, and purchasing agents in selecting chemical resistant cements to meet their particular problems. Because of the variety of conditions and constructions under which the chemicals listed are used, final selection should be based on an analysis of the problem by corrosion engineers of the cement manufacturer.

Controlled Volume Pumps

Milton Roy Co., Dept. MF, 1300 E. Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.

This 40-page bulletin 553 contains valuable information covering design and construction of these pumps. Other technical data includes capacity-pressure selection tables; types of capacity adjustments; standard and special designs, as well as packaged systems. A two-page chart describes typical applications in six major industries. Also included is a four-page materials selection chart in four colors, a valuable guide to chemists and engineers.

Technical Data on Gold Plating

Technic, Inc., Dept. MF, 39 Snow St., Providence, R. I.

A new technical data sheet on electroplated gold shows, for the first time, the way to scientific control of the process and also offers the scientist the most complete compilation of information on gold ever assembled; also some data, it is believed, heretofore unavailable.

Oven Control Instruments

The Bristol Co., Dept. MF, Waterbury 20, Conn.

A new catalog of control instruments for furnaces, ovens, dryers and kilns has just been published by the company. The catalog, No. P1255, features electronic Dynamaster potentiometer and millivoltmeter type pyrometer controllers, recorders and indicators. A wide variety of electric, air-operated, and electronic control instruments for use with fuel-fired and electric heating equipment of all types is listed. Complete engineering specifications and prices are given. In addition to numerous photographs, the catalog is liberally illustrated with diagrams of the various control arrangements and dimension sketches.

Corrosion Resistance of Copper and Copper Alloys

The American Brass Co., Dept. MF, Waterbury 20, Conn.

For twenty-seven years, continuous laboratory research and field study of the nature of corrosive attack on copper and copper alloys have been conducted by the company's technical staff. The results of this study have recently been brought up to date in a new 28-page booklet, Publication

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Barrel Nickel Plating with TRUE BRITE NICKEL BRIGHTENER

Increase Production

easy to control . . . cuts down on trouble that entails costly delays.

Save time

can be operated at a higher speed.

Reduce Rejects

gives unbelievable uniformity of deposit in recesses . . . brighter, white color.

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B-36R. This publication, first of its kind in the industry, explains the chemical and physical nature of corrosive attack in its various forms.

Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper base alloys when in contact with 183 different corroding agents.

In the recently-released, revised edition, more complete information has been added on stress-corrosion cracking, galvanic corrosion, fresh and salt water corrosion. A section has been added on the subject of atmospheric corrosion. The section on corrosion in petroleum refineries has been completely revised.

Pneumatic Control Accessories

Minneapolis - Honeywell Regulator Co., Industrial Division, Dept. MF, Wayne and Windrim Aves., Philadelphia 44, Pa.

New 16-page Catalog 8950 describes, illustrates and provides specifications for a wide variety of accessories for pneumatic control applications. Included are air pressure regulators, air filters, pneumatic switches, valve positioners, and other highly functional equipment. Data on control piping systems and the computing of air capacities are also included.

Fingerprint Remover Oil

Octagon Process, Inc., Dept. MF, 15 Bank St., Staten Island 1, N. Y.

The manufacturer offers a fact sheet bulletin describing their Froil which removes fingerprints, prevents their formation and protects machined parts during operations.

News from California

By Fred A. Herr

What is believed to be the largest galvanizing plant on the Pacific Coast was opened in May by the Emsco Manufacturing Co. of Los Angeles for use in corrosion preventive coating of miscellaneous small items, such as rivets and bolts, to chain link fencing, oil field pipe, structural steel bleachers, transformers and metal tanks.

A conception of the size of the new plant may be gained from the fact that its under-roof area of 43,067 square feet nearly triples that of the company's former galvanizing facilities. The installation has a capacity for galvanizing 3,000 tons per month. It is set up in three main divisions: A pickling and sandblast section of 15,000 square feet; galvanizing building, 17,000 square feet; plus new offices and warehouse of some 11,000 square feet.

Ten new reinforced concrete and steel pickling and rinse tanks have been installed including the following: One 37¼′ x 17″ x 59″ steel caustic tank equipped with two 2,000,000 BTU immersion burners; two 37¼′ x 17″ x 59″ steel water rinse tanks; One Koroseal-carbon brick lined concrete tank; four tanks 35′8″ x 5′ x 81″, two of which are lined with acid brick, and two with Koroseal; and one concrete preflux tank.

Also installed were two new galvanizing kettles, both 30½ feet long, one

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Stainless Pump Totally Enclosed Motor Portable—Wt. 60 lbs. 14″ x 16″ x 16″ high

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Model	Rated Capacity	Overall Size	Weight
LSI-5	50 gal/hr	11″ x 14″ x 12″	30 lb.
LSI-10	100 ″	12″ x 16″ x 16″	40 ″
ASI-300	300 ″	2′ x 2′ x 2′	125 ″
ASI-400	400 ″	2′ x 2′ x 2′	135 ″
ASI-600	600 ″	2′ x 2′ x 2′	150 ″

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Manufacturers of Welded Fabrications to Specification

having a capacity of 94 tons of zinc, and the other 62 tons. Overflow and waste solution from the units are handled in a new concrete acid brick lined neutralization pit, in which the waste is drained and neutralized before being dispatched into the municipal sewage system.

Emsco has switched from its former steam heating system for tanks to gas firing. The new tanks are heated by two-million BTU natural gas fired immersion heaters. The heaters are controlled individually to maintain constant pickling temperature without diluting the solution.

Behr-Manning Co. recently completed a new branch plant and office facilities at 16th and Missouri Sts., San Francisco, from which the northern California and Western Nevada districts will be served. This marks the last of a trio of branches recently opened by the company for servicing the eleven western states, other branches now being in operation in Los Angeles, Calif., and Seattle, Wash.

The new San Francisco building comprises 15,000 square feet of floor area for office, warehouse and display purposes. It includes a methods and equipment room which is equipped to present demonstrations of modern methods in the use of coated abrasives for various industries.

Attached to the northern California Branch are the following: *Joseph M. Bush*, divisional sales manager; *W. F. Ewing*, branch manager, and *Paul S. Biswell*, Pacific Coast regional manager.

Corrosion Engineers, Inc., was recently organized at Gardena, Calif. by *John Williams* and *Louis Simpson* to serve as distributor in the eleven western states for American Lucoflex, Inc., of New York, N. Y.

The firm has established manufacturing and office facilities at 1930 West Rosecranz Ave., Gardena, where it engages in the fabrication of tank linings and tanks for the electroplating industry, and also other acid resistant linings.

Williams is president, Simpson vice-president. Both were formerly employed by the Aircraft Seating Company, a manufacturer and finisher of seats for airplanes, which previously occupied the building now housing Corrosion Engineers, Inc.

Industrial Systems, Inc., Los Angeles, reports the addition to its technical staff of *Edward S. Allen* as chief design engineer. He was formerly affiliated with Electric Furnace Co. and Dempsey Industrial Furnace Corp.

A small business production pool has been organized in the Albuquerque, N. M., area, with fifteen firms as initial members. Known as Albuquerque Production Pool, Inc., the organization is composed largely of operators in the metal working and finishing fields, including machining, light and heavy fabrication, electroplating on both light and heavy metals, welding, electronics assembly and fabrication.

Bone Engineering Company, Glendale, Calif., reports the purchase of Centrifugal Investment Casting Company, also in Burbank, as part of an expansion program to augment its current activity in electronics and to assure it of a wider range of parts.

The company also announced the appointment of *Edward G. MacLennan*

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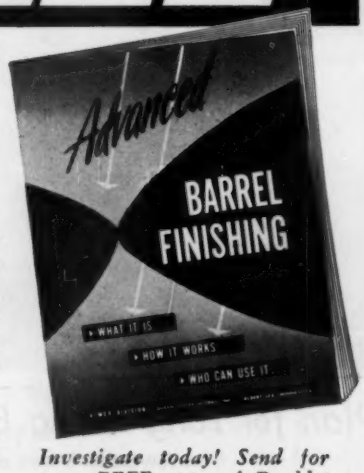
This amazing 22-page booklet is *guaranteed* to open your eyes! Gives latest, up-to-the-minute facts – figures – photos on advanced barrel finishing. Shows how single unit installation replaces from 2 to 12 men—*savings up to 95%* on almost all types of parts from large castings to small intricate parts.



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- NICKEL CARBONATE
- ZINC CYANIDE
- COPPER CYANIDE

IRITOX CHEMICAL COMPANY
5 UNION SQUARE WEST
NEW YORK 3, N. Y.
WAtkins 4-1977

as sales manager. He most recently served as western states factory representative for the Clifford Mfg. Co. of Boston, Mass.

Dr. J. B. Sutton has been promoted from manager of the DuPont Company's pigment sales office in San Francisco to sales manager of specialty products in the Pigment Division. *David A. Piguet*, who formerly served the firm as a pigments salesman in Detroit, Mich., has been named San Francisco manager, succeeding Dr. Sutton.

R. P. Toeppen, who during the past year was general manager, has been elected vice-president of the James H. Knapp Co., producers and designers of industrial furnaces in Los Angeles. *John B. Florance* has been appointed chief engineer.

Aircraft Metal Forming Company, Burbank, Calif., has announced the appointment of *R. F. Baird* as vice-president and general manager. He formerly served Petley, Inc., of Los Angeles in various executive capacities. The company also announced the appointment of *Seibly S. Buffum* as sales manager.

General Controls Co. has announced plans for the immediate start of construction on a new 120,000 square foot plant to augment manufacturing facilities for its Grayson-Greenmayer Appliance Controls Division. The new addition, the firm's third expansion within the past year, will be located on a site at Alameda and Flower Sts., Burbank, just across the street from the company's main plant in Glendale.

Alert Supply Co. of Los Angeles, and Northwest Chemical Co. of Detroit, Mich., for which Alert serves as Southern California distributor, have announced the appointment of *Harvey Hunt* as sales engineer in the Los Angeles and contiguous area.

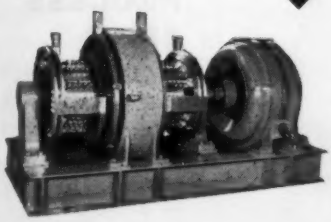
Hunt will specialize in servicing the Southern California plating and allied industries with Northwest's metal cleaners. His appointment was effective July 15, with headquarters at Alert's main office, 4755 East 49th St. Before starting the new job he spent a week at Northwest's Detroit plant for training and indoctrination.

Harvey Hunt

Hunt's appointment by Northwest and Alert Supply followed his recent resignation from the sales staff of the L. H. Butcher Co., Los Angeles, for which firm he had served the past five years as a metal cleaner compound sales engineer. Previously he had served in the technical division of Hanson - Van Winkle - Munning Co. in Matawan, N. J.

COLUMBIA

MOTOR GENERATORS



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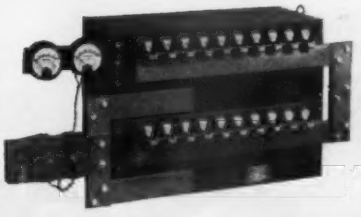

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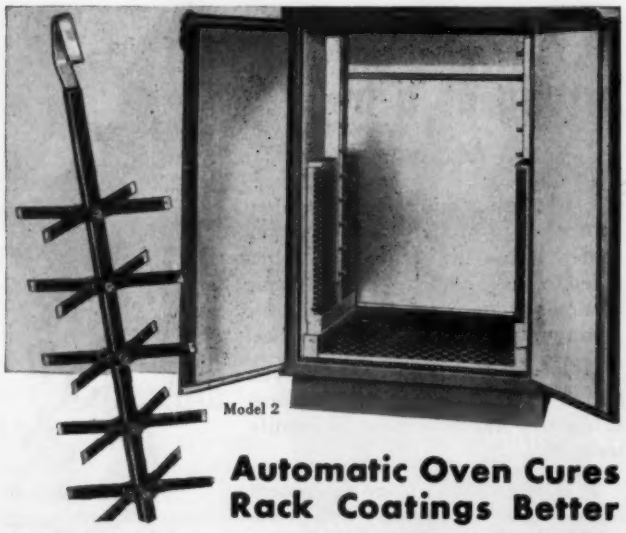
Monel PICKLING EQUIPMENT
extra life
extra capacity
extra safety

MOTOR CITY PLATING NEWS

C. H. McAleer Purchases McAleer Manufacturing Co.

The McAleer line of products is now back in the hands of its original owner, *C. H. McAleer*, president of *Detroit Chemical Specialties, Inc.*

The *McAleer Manufacturing Co.* was organized 30 years ago to supply car manufacturers with original lacquer rubbing compounds and polishing and buffing compounds. McAleer sold his interests in 1940. He returned to the field in 1946, when he founded Detroit Chemical Specialties, Inc., with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Automatic Oven Cures Rack Coatings Better

Automatically maintains correct preheating and curing temperatures for proper coating of plating racks. Holds any temperature for which set (between 300 and 450°F.). Layout of efficient Rack Coating Department and complete information on BELKE Electric Ovens in Bulletin 1061. Ask your BELKE Service Engineer, or write.

Inside dimen.	MODEL 1	2	3
WIDE	24"	36"	48"
HIGH	48"	48"	48"
DEEP	24"	24"	24"
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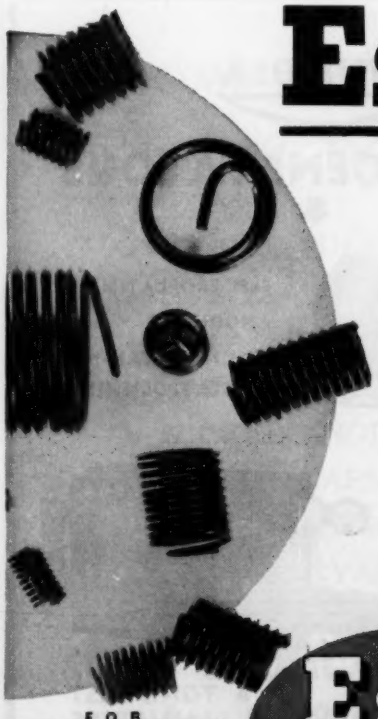

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C. H. McAleer

the "Detroit" line of polishing and buffing compounds and allied products.

The company will continue with this line, along with the McAleer line, including liquid polishes, waxes, polishing and buffing compounds for the plating industry, rubbing compounds, and other chemical specialties, which will be sold nationally direct to the trade and through distributors.

The company is located at 101 S. Waterman, Detroit.

Udylite Appoints Hohner

Appointment of *Clem H. Hohner* as district manager of the *Udylite Corporation's* southeast sales district was announced recently by *L. V. Nagle,* executive vice-president.

Hohner has been associated with the company for the past seven years. Prior to that time, he was with the Scripto, Inc., and Eagle Pencil Co. engineering departments. He is a graduate of the Michigan College of

Clem H. Hohner

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SMOOTHS . . . BRIGHTENS . . . DEBURRS

Removal of metal can be controlled down to .0002 of an inch.

COPPER ALLOYS	ELECTRO-GLO #200
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Mining and Technology, chemical engineering school.

Nagle also revealed that Hohner would take charge of Udylite's modern new warehouse and sales office now under construction in Atlanta. These new facilities will serve plating firms in North Carolina, South Carolina, Florida, Georgia, Alabama, and eastern Tennessee.

Rumbaugh Director of Sales For Klem

T. Curtis McKenzie, president of *Klem Chemicals, Inc.*, Dearborn, Mich., announces the appointment of *Roy Rumbaugh* as director of sales engineering. Previously Mr. Rumbaugh represented the company as a manufacturer's agent for eight years. Before that he spent 17 years with Ford Motor Co.

Mr. Rumbaugh's new position will place him in the field where he will work with Klem service engineers in an advisory capacity.

Diversey Adds to Staff

Three new D-Men have been added to *The Diversey Corp.'s Metal Industries Department* as sales representatives after completing an intensive technical and sales training course. They are *E. A. Warnecke*, *J. B. Rogers* and *W. E. Gilroy*.

E. A. Warnecke

J. B. Rogers

Warnecke now represents Diversey in Milwaukee and the state of Wisconsin. He has had previous sales experience in metal and related fields and is a graduate of the University of Wisconsin where he received his B.S. degree in Economics. He makes his home in Milwaukee.

Rogers is Diversey's sales representative in the Cleveland area. He attended Ohio Northern University receiving his degree in Business Administration, and since has gained a wealth of experience in selling. He makes his home in Cleveland.

Gilroy has taken over as sales repre-

KNAPP MILLS ANNOUNCES Three New Developments

FERROLUM ANODES

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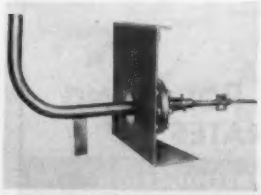

2. FERROLUM GAS HEATER

Low fuel cost, simple to operate, direct fired. Efficient, compact, economical, simple to operate and install. Sturdy, excellent corrosion resistance.

3. LEAD PLATE HEATER

High efficiency, low steam pressure. Large heating surface — Economical and efficient.

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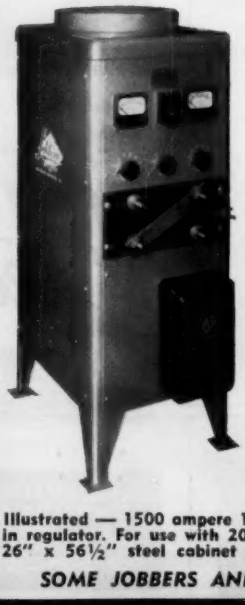

A Better Source of DC Power — More for Your Money

Now Lektron plating rectifiers are available in two types. (1) Lektron Selenium for cool zones, or (2) Lektron Magnesium-Copper Sulphide for the hot, dirty, tough jobs. Heavy duty transformers — husky fan motors — built to last. Built-in voltage regulation — meters — or remote control optional.

Units operate from minus 40° F. to 225° F. at 50 - 50,000 amperes DC. No failures in units working 4 years "round the clock." Investigate "Lektron" before you buy — get quality of product backed by a company of integrity at a "price you can afford."

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Illustrated — 1500 ampere 1 - 8 volt DC. Full wave type with built-in regulator. For use with 208, 220 or 440 volt 3 phase AC. 20" x 26" x 56½" steel cabinet in gray hammerloid. Weight 725 lbs.

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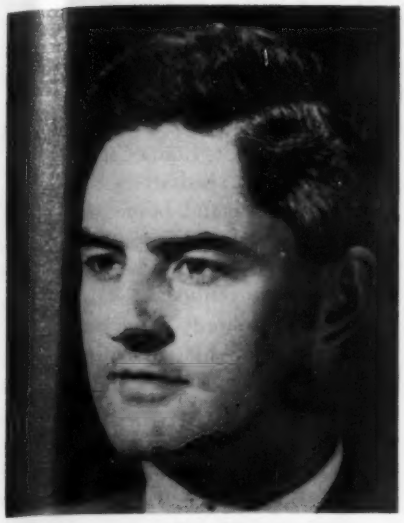

W. E. Gilroy

sentative in the state of Connecticut. He is a graduate of Cornell University and makes his home in Portland, Conn. His diversified sales background makes him ideally suited to his new position.

Imperial Rack in New Plant

E. L. Faulman,' Naraco's board of director's president, announced the consolidation of *Imperial's* Hazel Park and Flint, Mich. plants. Personnel and machinery from both these plants have moved to a larger location at 1109 East Stewart Ave. in Flint. This merger will enable the company to offer a more efficient service to the automotive industry in the area.

The new plant, now in operation, has over twice the area of both previous plants combined and its facilities include the latest conveyor and rack making equipment. Among the new equipment installed is a huge specialized tank for applying the firm's own insulation to oversized parts and equipment. The building also houses modern offices for the engineering staff. *James Bennet* has been appointed plant manager and *Alvin Smith* has been appointed sales manager.

Bennett is a graduate of General Motors Technical Institute and former process engineer for the Buick Motor Car Co. He also served three years with the Army Engineering Corps and is particularly well qualified to serve the automotive industry in the Michigan area.

Smith was formerly with the Buick

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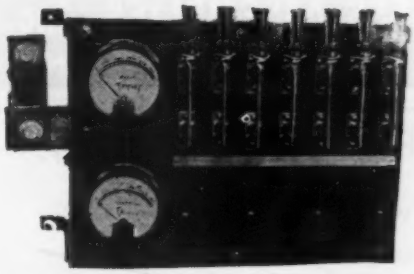

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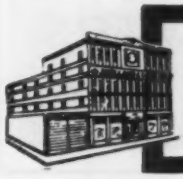

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Alvin Smith

James Bennet

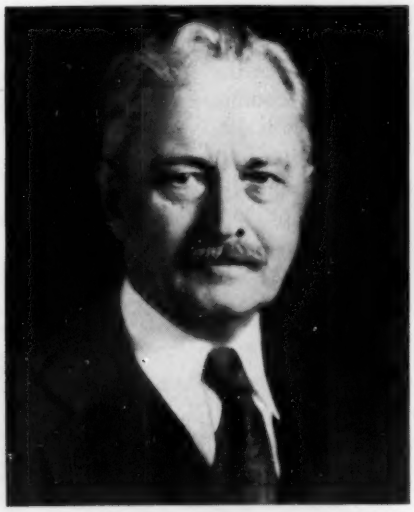
Motor Car Co. for twelve years and has had extensive experience in handling problems connected with designing and manufacturing plating racks and fixtures and materials handling equipment for the automobile trade.

We are in urgent need of copies of the June, 1952 issue of METAL FINISHING. If any of our readers have an extra copy we would appreciate their forwarding it to the following:

Metal Finishing
381 Broadway
Westwood, N. J.

OBITUARIES

PIERRE I. CHANDEYSSON
1875-1953



Founder and president of the Chandeysson Electric Co., *Dr. Pierre I. Chandeysson* died on June 5, 1953. Active in the management of the company until a year ago, death came in a St. Louis hospital following a coronary thrombosis.

Born in France, Dr. Chandeysson came to America at the age of seventeen. Eight years later, in 1901, he graduated from Washington University, College of Medicine, and joined the staff of the St. Louis City Hospital, specializing in pediatrics. Here his searching mind and boundless energy soon earned an esteemed reputation. But, it was in another field of science in which his genius was to find its highest expression. This came about as a result of his keen interest in electricity and mechanics. While studying at the University and in the years that followed, Dr. Chandeysson pioneered the design and development of low voltage, high current generators for electroplating use.

Electrical equipment at the turn of the century left much to be desired and the tremendous demands of American industry presented a challenge which he could not resist. He formed the Chandeysson Electric Co., gave up his medical practice and set about to the challenge of electrifying American industry. He seized every opportunity to apply his genius, making significant developments in telegraphy, ticker mechanisms, railroad signals, medical magnets and homo-

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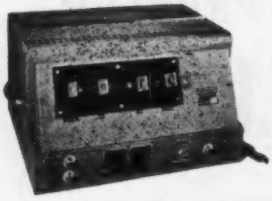

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polar generators used in railroad test cars for rapid rail defect inspection, to mention only a few.

As industry expanded, the demand for electroplating generators reached the point where the entire production of Chandeysson Electric was channeled into this activity.

In anticipation of his retirement, Dr. Chandeysson transferred his ownership of the company to a family trust 12 years ago, under which it has since operated. The present management includes *A. W. Chandeysson*, president; *J. F. Carland*, executive vice-president; *W. E. Schwarz*, vice-president; *T. A. Leonhardt*, vice-president; *D. Bundschuh*, treasurer and *K. Eggers*, secretary.

GAIL E. BARR

Gail E. Barr, superintendent of the Natrona, Pa., plant of the *Pennsylvania Salt Mfg. Co.*, died June 6 after a brief illness at his home in nearby Freeport. He was 56 years old.

Mr. Barr, who joined Pennsalt in 1912, first worked in the Natrona plant laboratory. He served in the A.E.F. in World War I and after returning to the company, became a process supervisor. He became production supervisor in 1943 and was promoted to superintendent in 1948. During his tenure as superintendent a number of new products and processes were introduced at the Natrona plant. Mr. Barr was also superintendent of the Natrona Light & Power Co. and the Natrona Water Co., Pennsalt public utility subsidiaries.

SUMNER SIMPSON

Sumner Simpson, 79, board chairman of *Raybestos-Manhattan, Inc.*, died June 13 at Bridgeport, Conn. He was an industrial and civic leader who for years has been rated as Bridgeport's No. 1 citizen and philanthropist. Self made, he started in the automotive business early in the century with Royal Equipment Co. which soon became Raybestos and which he headed through many years of growth to dominant leadership. Influential in the merger in 1929 which became Raybestos-Manhattan, Inc. he was its only president until a few years ago when he became chairman of the board. He was the first president of both the Community Chest and Rotary Club of Bridgeport, past president Union League Club of New York in addition to serving on many charitable and civic boards.

R. LESLIE BEATTIE

R. Leslie Beattie, vice-president and general manager of Canadian operations of *The International Nickel Co. of Canada, Ltd.*, died suddenly in Toronto on June 10th, at the age of 62.

Mr. Beattie's position embraced the management of the company's mines, mill, smelters, refineries and auxiliary operations in Canada. He was born on a farm near Caledonia, Ontario, and in November, 1911, joined the Canadian Copper Co., a predecessor of International Nickel. In February, 1935, he was appointed assistant to the general manager of the company's Canadian operations and assistant vice-president in February, 1940. In December, 1942, he succeeded the late *Donald MacAskill* as vice-president and general manager, and in 1943 he was elected a director of the parent company. He became a member of the executive committee of the board and also a director of the company's United States subsidiary, *The International Nickel Co., Inc.*, in 1952.

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Anti-corrosive Linings and Coverings
NO EQUIPMENT TOO LARGE or TOO INTRICATE

Mr. Beattie served with the Royal Canadian Engineers during World War I, and was awarded the Military Medal. Surviving are his widow, the former A. Edna Allen and three sons, Allan Leslie, Robert Gray and Donald Greer, and one grand-daughter, all of Toronto.

NEW BOOK

The Intelligent Use of The Microscope

C. W. Olliver. Published by Chemical Publishing Co., Inc., 212 Fifth Ave., New York 10, N. Y. Second Edition. 1953. Price $4.00. 192 pages including index.

This small book is the first American edition produced for the beginner using a microscope, which category includes most technical men in the plating industry. In a simple and lucid manner, it describes the hows and whys of microscopy but avoids an excess of theory. Equipment and accessories are described and there is a chapter describing measurements with the filar micrometer.

Although no information is given on preparation of specimens for microscope examination, platers will find this volume useful for an understanding of the precise functions of the instrument components and will be made aware of its limitations.

Associations and Societies

Los Angeles Branch

A talk on "Nickel Plating" was presented at the June 10 meeting of Los Angeles Branch, American Electroplaters' Society, by *Dr. Victor Zentner*, an electrochemist associated with Surface Alloys, Inc., of Los Angeles.

Dr. Zenter's international reputation in the field of electrochemical research attracted an overflow attendance of nearly 100 members and guests to the last branch meeting of the fiscal year. His initial researches in this field were conducted at the University of Leipzig in Germany, following which he was similarly active in England from 1940 to 1948. Since coming to the United States in 1948 he served under *Dr. William Blum* in the *National Bureau of Standards* for three years, and for the past two years has been with Surface Alloys.

Remindful of the fact that Dr. Blum had addressed Los Angeles Branch several months ago, in which nickel was touched upon as part of the general talk, Dr. Zentner used a different approach and directed his comment more to the general and more fundamental conclusions that can be drawn from the Bureau's researches, and to outline and underscore the underlying basic theory.

Dr. Zentner pointed out that to the practical electroplater and electro former it is of little help to know how to measure stress, although a small device, simple in operation, would be welcome. Although he was unable to offer any specific recipe for reducing stress, he declared that it is felt that nearly all organic additions to a nickel plating bath act in some unexplained way as stress reducers.

The business session began at 8 p.m., with president *John Millhorn* in the

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chair. Guests introduced included *W. H. Stoddard* of Wildberg Bros., *Norman Larson* of Southwest General Light Co., and *Charles Zayorkas* of A. F. Holden Co. New members initiated were *A. E. Kennard, Ray G. Skaggs, Ford Colling* and *V. Herbert.*

Millhorn read a letter from *R. A. Downs*, secretary of Adelaide, Australia branch, in which Los Angeles Branch was requested to serve as proxy for Adelaide at the Philadelphia convention. In the letter Downs requested Los Angeles delegates to present at the convention the views of Australian members with regard to the recent increase in membership fees. Downs stated that Australian platers could ill afford to pay the additional fees and expressed the view that membership in Australia may show a decided drop as a result.

Norris Freeman of Twentieth Century Light Co. proposed that Los Angeles Branch sponsor a move to persuade the Supreme Society to admit foreign members at reduced dues and research fund fees. This proposal received only scattered support on the theory that Australian members receive invaluable benefits from research project results in relation to their own contributions to that work.

The Los Angeles delegates — *Richard Wooley, Morton Schwartz* and *Earl Arnold* — were instructed to present the Australian proposal to the convention by reading Secretary Downs' letter at the general session.

Gilbert Extale advanced the thought that in the future all technical papers presented at the convention should be included in the convention proceedings. He pointed out that, in the past, some papers that had been published previously in *Plating*, had not been included in the Proceedings.

An invitation to visit the Kaiser Steel Co.'s plant at Fontana, Cal., was accepted. The visit will be made some time in July and will include the ladies.

The branch will hold its annual picnic in mid-summer on a date to be decided by the board of managers at an early meeting. What has in the past been euphemistically referred to as a baseball game will again be on the program, with an aggregation of plating shop owners and employees opposed to supply house representatives.

Branch Tours Plant

With regular monthly meetings discontinued during July and August, librarian *George Magurean* of Los Angeles Branch arranged an interesting plant tour on the night of July 9.

Approximately 125 members and guests, including about 20 wives, toured the Kaiser Steel Corporation's steel making and processing plant at Fontana, Calif. Arrangements had been made for those who wished to do so to eat dinner in the Kaiser Company's cafeteria at 6 p.m.

Before the trip through the vast steel plant began at 7 p.m., members of the A.E.S. group were given orientation talks by company representatives. The platers were taken through the plant in groups of 12 to 15, each group headed by a Kaiser attendant who presented a running account of each operation. The plant area is so extensive that walking was out of the question. The A.E.S. visitors rode in their own cars from building to building, leaving the machines for walking

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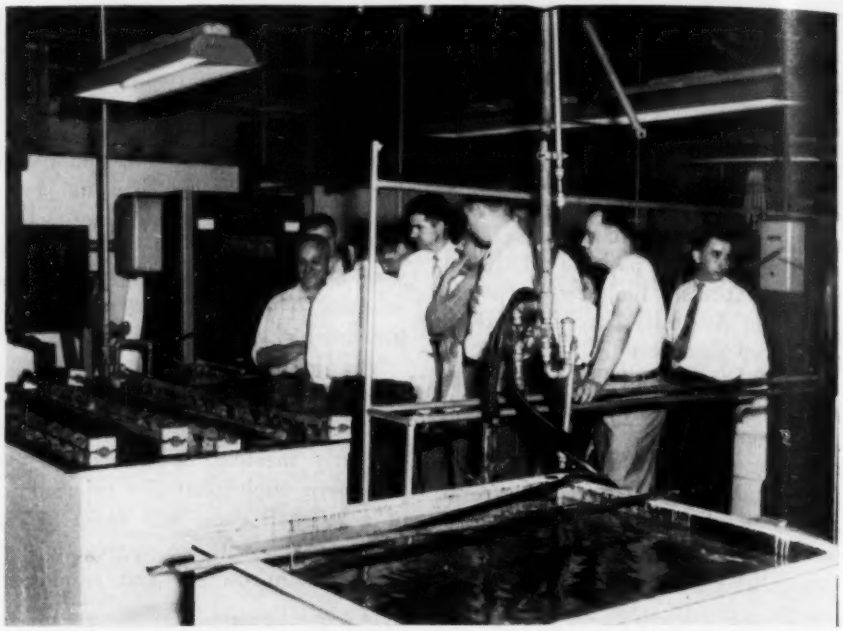
tours through the various structures.

Departments toured included the tin plate mill, blast furnace division, rolling mill, open hearth furnaces and coke ovens. The entire trip required about 3½ hours.

Members of the Los Angeles A.E.S. group were particularly interested in the tin plating operations which touched their own field more closely than the milling, cutting and blasting operations. The tinning facilities consist of an immersion system using tin sulphate bath. The size of these operations impressed the visitors as they viewed the operations from cat walks high above the working levels. Machines resembling nothing less than huge newspaper rotary presses are used. The tin sheets pass through the solution and are then formed into huge rolls of sheet tin. A hot-dip process and an electrolytic setup for tin are also in operation at the Kaiser plant; as well as automatic machines used in after-plating operations for tempering, with the sheets passing through a temper pass at the amazing rate of 4,000 lineal feet per minute.

Los Angeles Branch officers were present nearly 100 per cent, including president *John Millhorn* of the Mefford Chemical Co.; first vice-president *Stuart Krentel* of A. J. Lynch Co., 2nd vice-president *Earl W. Arnold* of L. H. Butcher Co.; librarian *George Magurean* of U. S. Spring & Bumper Co.; sergeant-at-arms *Alex Heller* of Atlas Plating Co.; and board members *R. J. Wooley* and *Roy Lostutter*.

Los Angeles Branch will resume regular monthly business meetings on September 9. The highlight of the summer season will be the forthcoming annual picnic, featured by a baseball game between teams composed of plating shop owners and employees and representatives of the supply houses.



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